Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. 58. NEW YORK, SATURDAY, OCTOBER 28, 1911. No. 18.

ELECTRICAL WORLD

Published Weekly by

McGraw Publishing Company

James H. McGraw, Pres.; C. E. Whittlesey, Sec'y.

239 West 39th Street, New York.

Chicago, Old Colony Building.
Philadelphia, Real Estate Trust Building.
Cleveland, Schofield Building.
London, Hastings House, Norfolk St., Strand.

Subscription price in United States, Cuba and Mexico, $3 per year. Canada, $4.50; elsewhere, $6. Foreign subscriptions may be sent to the London office. Requests for changes of address should give the old as well as the new address. Date on wrapper indicates the month at the end of which subscription expires.

Changes in advertisements should reach the New York office ten days in advance of the date of issue. New advertisements are received up to Wednesday noon of the week of issue.

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Entered at the New York Post Office as Second Class Mail Matter.

The circulation of Electrical World for 1910 was 974,750. Of this issue 17,000 copies are printed.

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EUROPEAN 110,000-VOLT PLANT.

We are glad to note in this issue the installation of the first European plant at voltage exceeding 100,000. Very long transmissions are not sufficiently numerous abroad to encourage the use of extreme voltages, yet this plant is well up to the present American limit, although as a matter of fact the distance of transmission at present is only about 35 miles. In a short time, however, this country will have advanced to the 140-000-volt limit, commencing with an installation in Michigan. The European plant is at Lauchhammer, Germany, and is particularly notable as being steam-driven, using coal at the mouth of the mines. The initial equipment consists of two 5000-kw turbo-generators, delivering energy at a voltage of 5000. The steam-producing plant is out of the ordinary from the standpoint of American practice in its use of simple double-flue boilers, a peculiarity due possibly to the nature of the fuel. They are, however, equipped with automatic stokers, economizers and superheaters, and are operated by artificial draft. The extraordinary voltage used for so short a transmission is due first to the fact that the ultimate energy will be some 20,000 kw, and second, to the question of standard accessory apparatus, including transformers. Any voltage over 65,000 required special design, and so having determined in the interest of economy to go above this figure they apparently decided to play the limit. From the generating plant the energy goes at 5000 volts to the switchhouse. Here duplicate busbars are provided, connected with the raising transformers, which themselves feed into duplicate 110,000-volt busbars. Disconnecting switches and oil switches are installed on both sides of the transformers and also on the outgoing high-tension transmission lines.

The transmission line itself presents some interesting peculiarities. It consists of a duplicate system of three-phase conductors carried on a single line of iron towers. Three cross-arms are provided, the one at the top of the tower being arranged to carry four wires with the outer ends of the cross-arms turned down so as to bring the outside wires on either side of the tower in position to form an equilateral triangle with the two others of the circuit, carried respectively on the upper cross-arm nearer the tower and at the end of the short lower cross-arm. All wires are carried on five-disk suspension insulators. There are thus two complete circuits, one on each side of the tower, 5.9 ft. between centers and completely transposed once a mile. At the extreme top of the tower is a 100,000 circ. mil steel cable grounded, and serving to help in anchoring the towers and to protect against lightning. In addition, the third and lowest cross-arm on each tower carries a bow-shaped guard under each one of the circuit wires, on which, if the insulator should break, the wires would be instantly grounded. In other respects the construction is

quite similar to that of our own high-tension systems, and it is worth noting that an American automatic regulator presides over the voltage in the power house. To the American engineer decidedly the most interesting feature of the system is the tower line. It impresses one as being neater, lighter and probably cheaper than the ordinary American construction, and the arrangements for suspending and guarding the circuit wires are certainly excellent. The base is only about 27 in., so that the structure resembles a latticed pole rather than a typical tower, and is possessed therefore of a certain flexibility which is of use in case a wire breaks under extraordinary load.

A METHOD OF DETERMINING EQUIVALENT CONSTANT HEATING CURRENTS.

In the design and operation of railway motors it is important to be able to compute the equivalent constant current whose heating effect is equivalent to that of a variable-current régime imposed upon the machine in cycles of service operation. In order that the motors may not be overloaded their temperature elevation must be kept within certain assigned limits, and this in turn depends upon the I^2R losses integrated over the period of service. But the current I in the motor is necessarily very variable. Nevertheless, it goes through a certain regular cycle in the operation of a railway train. If a steady current can be found whose square will produce in the long run the same heating as the service régime, it becomes possible to test the motor with this equivalent current and to ascertain by experiment the temperature elevation produced. The computation of the equivalent heating current for a given curve of actual currents obtained from a recording-ammeter chart with rectangular co-ordinates of amperes against time is a very tedious and lengthy task. A much simpler and very practical method was described in a paper by Mr. C. O. Mailloux read before the International Electrical Congress of Turin.

The method of Mr. Mailloux consists in obtaining the record of variable currents in polar co-ordinates, the time being represented by the angle and the current strength by the variable-radius vector. Thus, for electric-railway service one complete revolution, or 360 deg., may be allotted to five minutes of time, after which a new polar chart must be started. There would thus be six such charts covered in a service run lasting thirty minutes. By means of an ordinary planimeter, and especially by means of a particular type of planimeter called the integraph, the sums of the areas of all the polar-current charts are then obtained mechanically and the mean-radius vector is quickly determined. In the particular process described this mean-radius vector is evaluated mechanically with practically no resort to arithmetic. The equivalent heating current follows immediately from this mean-radius vector. According to the data contained in the paper, the method can be applied in one-tenth of the time necessary for arriving at a result of like precision with ordinary rectangular co-ordinates of amperes and time. Moreover, the liability to mistakes is greatly reduced by the new process. The method is practically an extension of that originally introduced by Fleming for the determination of the virtual-current strength corresponding to a complex alternating-current wave-form. Whereas, however, the Fleming method was confined to a single half-wave, or 180 deg. of rotation, the new method is extended to cover as many complete rotations or fractions of the same as may be necessary and the summation of successive rotations is very simply and elegantly conducted.

EFFECT OF POWER-FACTOR ON SYNCHRONOUS CONVERTER RATING.

In the case of an ordinary direct-current generator or motor everyone who has had experience with such machines knows that their armatures become heated by the working armature currents under load and also that this heating is normally uniform over all of the armature coils. If an ordinary direct-current machine, under normal load, develops more heat in some particular coil or coils than in the others, it is evident that there is some defect in the machine, such as a short-circuited turn in the coil. The same is true in the case of an ordinary alternator. Whatever heat is developed in the armature winding by I^2R loss is uniformly distributed through the winding. Nevertheless, an exception to this condition is presented in the armature of a converter, which is a sort of hybrid between a direct-current and an alternating-current machine. A converter also presents analogies to a revolving commutator, so that its thermal behavior is relatively complex by comparison with that of either a direct-current or an alternating-current generator.

The heating of converters has, however, received much attention, because it is this heating which assigns and delimits the rating of such machines, assuming that the commutation can be kept satisfactorily free from sparking. It is well known that converters develop no appreciable torque about their shafts beyond that due to friction, so that the normal mechanical stresses which they have to withstand are due only to accelerations either in starting, stopping or responding to changes of frequency on the system supplying them. Consequently they are not only very light in weight for their output, compared with generators, but if their heating could be reduced they could be made to carry still greater loads without the need of much mechanical reinforcement.

Mr. Ralph D. Mershon published an early article on "The Output of Polyphase Generators and Rotary Transformers" in our columns of June 15, 1895, dealing with the quantitative relations of the I^2R armature heating of these machines. Other contributions to the literature of the subject have been made at different times by Dr. Steinmetz, Dr. McAllister and others. The heating of converters has also been much studied and reported upon in Europe. Most of the discussions concerning the I^2R heating of converter armatures under load have assumed that the machines were operated at unity power-factor, and the average heating of the armature was sought for comparison with the average heating of the same machine receiving or delivering the same load current as motor or generator respectively. It has been repeatedly pointed out, as was shown in the above-mentioned Mershon article of 1895, that six-phase converters had a greater output than quarter-phase converters, and these in their turn had a greater output than three-phase converters. Relatively

few of the discussions have covered the conditions of heating with reduced power-factor—that is, when the incoming alternating currents are not in phase with the generated emf in the armature. It is known that the heating is considerably increased under such conditions; or, to express the same facts in another way, the current output of a polyphase converter for a given permissible temperature elevation must be distinctly reduced if it has to operate at a reduced power-factor.

The I^2R heating of converter armatures is far from being uniform. The coils at one end of each armature segment nearest to the taps become the most heated and attain a temperature elevation in excess of the others. Theoretically this inequality might be reduced by making the turns in those coils of larger cross-section. The complication in manufacture and repairs introduced by such an expedient has, however, never been held to repay the advantage thereby obtainable. Consequently the output of converters is apt to be kept below what might be reached with the average armature heating, owing to the disparity of heat generation in the different coils and slots of the armature. The article by Mr. Nicholas Stahl appearing on page 1060 of this number discusses this inequality of heating in the coils of converter armatures from a mathematical standpoint. It shows that the heating of the end-coils or tap-coils is considerably greater than that of the middle coils, even at unity power-factor, and that the disparity increases at one end-coil as the power-factor is reduced, although it diminishes at the other end, the rear tap-coil receiving at 80 per cent power-factor much less heating than the middle coils.

THE LIFE OF METALLIC-FILAMENT LAMPS.

An interesting study of the life of tungsten lamps in service under commercial conditions was recently reported in one of our foreign contemporaries. The scene of the investigation was Poitiers and the experiments were made on the municipal plant in the interest of the municipality. The lamps were run both on direct current and alternating current, four makes of lamp being tried out on the former and three on the latter. The candle-powers were mostly very moderate and four makes of 16-cp, 120-volt lamps were included in the list. On direct current, in particular, the results obtained with these low candle-power lamps were somewhat remarkable. In a group of four 16-cp, 120-volt lamps, each by a different maker, one gave out at ninety-four hours, but the other three endured to 1528 hours, 2300 hours and 4229 hours respectively. The lamp last mentioned had fallen to 11.3 cp at the end of its life, but held up to 80 per cent of its initial candle-power for 3400 hours. Meanwhile neither of the other specimens had fallen off 20 per cent at the end of its life. The 25-cp lamps went rather better. One make failed at 646 hours, another at 1045 hours, a third at 2500 hours and still another at 2981 hours, all without falling off 20 per cent in candle-power. The wattage of these small lamps seems to be, in the practice of Continental makers, very various, which to a certain extent accounts for idiosyncrasies in life, although in the case of the 16-cp lamps it is interesting to note that the example of longest life was of singularly low specific consumption, dropping below 1.2 watts per candle only after some 2800 hours of service. The next size larger lamps, of 32 cp, did materially better. Of this size a sample of one make lasted 2228 hours, another 2422 hours, a third 2773 hours, and the fourth was still running after 2900 hours, having then fallen off just 30 per cent of the candle-power. On alternating current the results were astonishingly bad, no lamp of any make or size going materially beyond 2300 hours and most breaking short of 1000 hours. Only two, in fact, passed the latter figure, one a 50-cp lamp and the other a 25-cp lamp.

In discussing the cause of this extraordinary difference in life between direct current and alternating current, the investigators are disposed to regard it as due chiefly to the fact that the commercial network for alternating current is subject to rather bad regulation owing to the large number of motors on the service. This judgment as to the cause of the phenomenon is in all probability correct, since no experiments here have tended to show any material difference in life between tungsten lamps burning on direct current and alternating current. One curious and noteworthy fact in these tests is that with very few exceptions all the lamps tested were overrated in candle-power and in most cases also overrated in efficiency. We hear a good deal about the high efficiency at which the foreign makers run their tungsten lamps, but the indications of this impartial, if somewhat incomplete, test are that whatever may be done in the case of selected groups of lamps the commercial product is less accurately rated than our own. For instance, the 32-cp lamps tested ran from 1.2 initial watts to as high as 1.54 initial watts per candle and the 25-cp lamps from 1.29 watts to 1.55 watts in the tests on direct current, while on alternating current three lamps which started out at just over 1 watt per candle had all failed by the end of the first 400 hours. The long and short of the matter seems to be that the American users of tungsten lamps have little cause for anxiety over the life or the uniformity of the American product. A casual group of American tungsten lamps by various makers would certainly show as good results in life, and rather better in uniformity, than was secured in the Poitiers test.

The sole fact of special interest to American practice is the very creditable results that seem to have been reached with tungsten lamps as low as 16 cp. The test itself certainly shows, in spite of the small number of lamps investigated, that there is a reasonable expectation of life on a circuit of good regulation for these little lamps at voltage as high as 120. In other particulars the American user has certainly reason to be well satisfied with the quality of the present product as compared with the commercial foreign lamp, although some foreign-made tungsten lamps show consistently results that are quite comparable with those reached here. The active competition in manufacture of the metallic-filament lamps abroad does not seem yet to have led to the evolution of any noticeably superior product. It seems to be the old story of American engineers taking up a foreign product and putting it in first-class commercial shape so as to reach final results at least as good as the best attained abroad. The evolution thus carried on always takes time, as it has done in this case, but it seems to have arrived.

Final Disposition by Patent Office of Heany Tungsten Lamp Cases.

The period having expired during which appeal could be made, the United States Patent Office has made public the decision, rendered July 7, 1911, of Assistant Commissioner C. C. Billings in the Heany tungsten lamp cases. Three applications made by John A. Heany, of York, Pa., for patents on tungsten lamps were involved, and in the decision all were finally rejected on the ground of fraud. The final rejection of these applications dissolves interference with a number of pending tungsten lamp patent applications, which can now resume their routine course through the Patent Office.

The Heany applications thus finally rejected were the subject of a criminal suit in the Supreme Court of the District of Columbia, filed early in 1908 and reported at the time in these columns, in which Barton, an assistant patent examiner, Everding, a patent attorney, and Heany were indicted for conspiracy, forgery and the destruction of original pages of a patent application and the substitution therefor of new pages. Prior to the commencement of the trial Barton pleaded guilty; Everding and Heany were tried, the jury convicting the former and acquitting Heany. Both Barton and Everding were sentenced to the penitentiary for terms of three and two years, respectively.

The present proceedings were based upon charges filed by Principal Examiner A. F. McKinnan and by Kuzel, Just, Hanaman and von Bolton, inventors, who were involved in interference proceedings with Heany. The General Electric Company, as assignee, was also represented among the counsel pressing the charges. The applications involved were the original Heany application filed Dec. 29, 1904, on which a patent was issued Jan. 29, 1907; a divisional application filed Aug. 31, 1906, and another divisional application filed Nov. 19, 1906. The charges are that Everding and Barton, aided and abetted by Heany, removed from the files of the Patent Office two sheets of the specification of the original application, substituting therefor two other typewritten sheets containing, among other matters which were not in the application when filed, a reference to the use of paraffine as a binder and also a description of the use of metals in a state of colloidal suspension, instead of the powdered forms of the metal; and that thereafter Barton inserted, by means of a typewriter machine, on the sheets which had been fraudulently substituted, the words "pure chromium, molybdenum, thorium, manganese or alloys thereof," and elsewhere inserted the words "osmium, cerium, niobium, tantalum, vanadium or boron and silicon," and elsewhere after the word "hydrogen" inserted the words "or nitrogen"; that Barton, in behalf of Heany, fraudulently stamped an amendment and entered it on the examiner's register and upon the file wrapper as of a previous date, namely, Aug. 26, 1907. Charges are also made in connection with the application of Aug. 31, 1906, and Nov. 19, 1906. In the criminal proceedings against Barton and Everding it was charged that the fraudulent substitutions were based upon knowledge, provided by Barton, of the subject matter in patent applications relating to tungsten lamps which were filed by other inventors.

When the present proceedings were initially instituted, the defendant instituted proceedings in equity in the Supreme Court of the District of Columbia, asking for an injunction restraining the Commissioner of Patents from striking the patents of Heany from the files of the Patent Office or considering the charges of fraud made by Principal Examiner A. F. McKinnan, on the grounds that Heany's acquittal in the criminal trial barred further proceedings. The court granted a temporary injunction restraining the commissioner from proceeding in the case, which injunction was later reversed on appeal.

Commissioner Billings in his very able opinion states that, in view of the grave charges that have been preferred against the Heany applications, it is deemed expedient and proper to institute proceedings before the parties to the interference should present their proofs upon the question of priority of invention, for the reason that if it should be found that the Heany applications had been fraudulently changed and modified, as alleged, and to be incapable of amendment, it is clear that Heany has no right to demand an interference with other applicants for a patent and has no status in such a proceeding. It is added that it would be a travesty and against all legal principles to permit a party to an interference to remain a party thereto should it be found that the very applications of that party involved in the interference are fraudulent to such a degree that no valid patent could be based upon such applications; or, in other words, that any patent or patents granted upon such applications would be invalid and void on the ground of fraud.

It is stated that in the injunction case the Court of Appeals held that the question as to whether Heany connived at and approved the attempted tampering with his applications in the Patent Office is not *res adjudicata*. That court also held that if the commissioner should find the alterations in an application to have been made without the knowledge and consent of the applicant, he will permit it to be corrected so as to restore it to its condition as originally filed. Should he, on the other hand, find that it was tampered with by connivance and approval of the applicant, he will enter an order rejecting the application, leaving the applicant his right to appeal therefrom. The opinion goes fully into the question whether Heany connived at and approved of the alleged fraud, and the decision of Assistant Commissioner Billings is that Heany was a party to the fraud.

Counsel for Mr. Heany, while admitting as facts the testimony of Mr. Barton in the criminal suit giving details as to the fraudulent addition of new matter to the application of Mr. Heany, maintained that their client did not have any personal knowledge of such fraudulent action and that he should be permitted to correct his applications and thereby receive the benefit of such prior invention as the applications in their original form disclosed. The assistant commissioner, however, ruled that from the testimony given during the proceedings he was constrained to hold that Mr. Heany was not only privy to the frauds concerning the filing of his two divisional applications and the original application upon which the former are alleged to have been based, but was an active participant therein; and that the whole proceeding involving these three applications is so permeated with falsehood and fraud on Mr. Heany's part that no valid patent can be granted on any of these applications. In the opinion it is stated that, of the three original sheets of the application of the 1904 or the parent application, the only one now on file is the third sheet containing two and one-half claims and these cannot be rightly used as a foundation upon which a specification can be erected; therefore, the amendment to this application offering two sheets as identical with those removed is refused not only on the ground that the application is so permeated with fraud as to be in law no application, but also on the ground that there is nothing appearing in the evidence on which to base a just and correct conclusion as to what the original specification contained when filed.

Aside from the confession during the criminal trial of Mr. Barton, in the present proceedings other testimony was considered as to Mr. Heany's complicity in the fraud, and it is stated that when Mr. Heany was called for testimony he refused to answer interrogations. The opinion reviews the testimony offered for the purpose of showing that Mr. Heany had invented a pure tungsten-filament incandescent lamp prior to Dec. 29, 1904, and that there could have been no motive on his part, therefore, in perpetuating the frauds specified in the charges, and admitted by the re-

spondents in their answers, to have been made in that application. In support of this contention, a witness, Mr. Simon, produced a pocket notebook, a shop book of his work, together with perfected lamps, which he testified were made under Mr. Heany's direction between May, 1903, and May, 1904; but Mr. Simon subsequently confessed that these lamps were not made until 1908 and 1909. Thus, instead of showing that Mr. Heany was in possession of the invention prior to December, 1909, it tended to show that if Mr. Heany was capable of thus manufacturing evidence he was equally capable of fraudulently altering the recorded evidence that his application filed in the Patent Office is supposed to furnish. Another witness, Mr. Urmson, who produced notebooks and experiment sheets similar in character to those of Mr. Simon, admitted that his books were not written until years after the dates they bear. It is stated that, likewise, Mr. Heany's notebooks, experiment sheets and other documentary evidence introduced by him are entitled to no weight as contemporaneous records, in view of Mr. Heany's explanation as to how they were kept in his laboratory, and his admission that they might have been made long after the occurrences or experiments to which they are purported to relate. The experiment sheets of one of the Heany exhibits were clearly shown to be fraudulent by the testimony of two witnesses.

There was produced in evidence correspondence that took place in 1904 between Mr. Heany and the General Electric Company, which showed that an option was given to the latter company by Mr. Heany. This option, however, was dropped by the General Electric Company before it expired, for the reason that officials of that company were satisfied that Mr. Heany had produced nothing of value. The correspondence tended to show, moreover, that not only were Mr. Heany's efforts in 1904 to produce a successful incandescent lamp failures, but that he was working upon composition instead of pure tungsten lamps. A witness who worked for Mr. Heany from June to October, 1904, testified that in this period the only use made of tungsten was to add a small amount of it to the oxides of the rare metals in the production of electrodes for arc lamps, and that Mr. Heany never explained or showed to him any tungsten incandescent-filament lamps. A lamp introduced in evidence by Mr. Heany, alleged to have been made prior to 1905, and to contain a pure tungsten filament, when tested in the presence of Assistant Commissioner Billings during the taking of testimony, showed that the platinum became white-hot, while the filament showed no light, thereby showing it to be inoperative. In reply to an assertion that he had exhibited to him a V-shaped tungsten-filament lamp in the early part of 1904, Examiner McKinnan, of the Patent Office, stated that such a lamp was not shown him until 1907.

In commenting on this line of testimony the opinion states that the evidence tends to show that Mr. Heany was working on many lines during 1904, such as the development of insulated-wire machinery, miniature arc lamps, composition-filament incandescent lamps, and glowers composed of oxides in the nature of self-starting Nernst glowers. The evidence fails, however, to show that Mr. Heany had developed a successful tungsten-filament incandescent lamp; and even if Mr. Heany did some work with tungsten in 1904, and had some idea that it might be possible to produce an incandescent lamp with a tungsten-filament, the evidence fails to show that he had a conception of an operative tungsten-filament lamp or a successful method by which it might be produced at that time.

One exhibit consisted of written instructions on a printed sheet stated to have been given by Mr. Heany to his assistant prior to Dec. 8, 1904, but a witness, who was proprietor of a printing office in New York, testified, by evidence most convincing, that he did not print and deliver the printed sheet until July 26, 1905. Mr. Heany was given an opportunity to rebut this testimony, but refused to appear for further examination. The opinion states that several witnesses testified to boasts made by Mr. Heany as to his ability to influence the Patent Office, one testifying that Mr. Heany said that a man in the Patent Office had been keeping him posted on what was going on and also helped him prepare patent specifications; that Mr. Heany occasionally, in unguarded moments, boasted to employees that he was the only man who had succeeded in getting next to the Patent Office; that he often reiterated to his employees that they must understand that Barton's relations with him were "perfectly straight," but that Barton was so rash that he would ultimately get them all in trouble. The opinion also refers to testimony indicating that fraudulent specifications and claims were prepared at York, Pa., by Mr. Everding and Mr. Barton with Mr. Heany's knowledge; that Mr. Heany frequently came into the room where the typewriting was being done, and that Mr. Heany and Mr. Everding conversed during the dictation.

The formal decision of Assistant Commissioner Billings is that the parent application and the two divisional applications at issue are finally rejected, and patents thereon are finally refused on the ground that any patent granted in view of the established facts would be held in the courts to be null and void and of no effect on the ground of fraud. It is ordered that upon the termination of the proceedings each of these three applications shall be indorsed with the words "patent refused on the ground of fraud," and each of them shall hereafter be kept in the archives of the Patent Office separate from the other applications for patents.

The Incandescent Lamp Situation.

Following the decision of the United States Circuit Court in the incandescent lamp suit, which was fully reported in these columns last week, there is much very natural inquiry as to the ways and means by which the General Electric Company will adjust its lamp business to meet the mandate of the court. It is now known that the General Electric Company owns outright the National Electric Lamp Company and its twenty constituent companies. At the time that the government suit was begun last March the General Electric Company bore a dual relation to these companies. It owned a majority of the stock, but by contract full control rested with the minority stockholders, and it was the owner and licensor of certain patents under which the National company and its subsidiaries operated. After the government suit was instituted the General Electric Company found it expedient (in accordance with an option created by a previosly existing contract) to buy the minority interest in the National Electric Lamp Company. The decree entered on Oct. 21 was drawn in accordance with this condition.

No official public announcement has yet been made as to the way in which the General Electric Company will meet the situation, but by reliable authorities it is stated that every effort will be made to retain those features of the National organization which made it effective in the development of the lamp business. Messrs. Terry and Tremaine will have general supervision of these properties and the local executives will remain the same. The engineering, manufacturing and selling facilities will, it is stated, be continued practically unchanged, and the rivalry which has hitherto existed in development work, as well as in selling, between the National companies and the lamp department of the General Electric Company will be encouraged as much as possible. Also, the practice which has hitherto prevailed of giving all of the licensees full information as to the discoveries, progress and development made by each of them will be continued in the belief that this policy makes for more rapid and efficient progress in the art of lamp manufacture.

The fact that the General Electric Company is the owner of each of the twenty odd companies hitherto embraced in the National organization will be made clear by some such legend as "owned by the General Electric Company" in connection with the printing or writing of the name of each of the companies.

The details incident to the necessary recasting of the entire lamp organization are naturally enormous and the officers of the several companies have been in constant conference for several weeks working on the readjustment to conform to the new conditions. One of the most important questions to be worked out is the matter of future price contracts. Owing to the inhibition of any attempt to control the re-sale price of lamps all existing price contracts must be canceled and new arrangements made in their stead, and that work is now going forward as rapidly as possible.

Briefly, therefore, the situation, so far as information is now obtainable, may be summarized as follows: In so far as the form and legal relations of the General Electric Company to its subsidiaries in the lamp business were declared to be contrary to law they will be discarded. In so far as those features of research, manufacture and distribution which made the operations of the National companies economically efficient can be retained they will be retained.

Telephone Toll Lines as Common Carriers.

An important proceeding has been instituted before the Interstate Commerce Commission, which body is asked for a ruling on the question whether a telephone toll line company is a common carrier and also to formulate rules and regulations to govern the operation of and charges for telephone toll-line service. The application was made by the Home Telephone Company, of Clarksville, Tenn., which filed a complaint against the Cumberland Telephone & Telegraph Company, a subsidiary of the American Telephone & Telegraph Company. The Clarksville company formerly had a toll-line connection with the Long Distance Telephone & Telegraph Company, which was later taken over by the Alabama & Tennessee Telephone & Telegraph Company and finally sold to the Cumberland company. According to the complaint the Cumberland management immediately cut out its connections with the Home company and refused to render it toll-line service.

According to a law passed June 18, 1910, the Interstate Commerce Commission is given jurisdiction over telegraph, telephone and cable companies, but there has as yet been no ruling as to whether such jurisdiction includes the requirement that telegraph and telephone companies shall file tariffs with the commission before putting them into effect, as in the case of railroad companies. The counsel for the Home Telephone Company takes the position that, since railroads under the law relating to common carriers cannot refuse the use of their rails to other companies desiring them for interstate business, the Independent telephone companies can demand and secure the use of toll-line service in consideration of reasonable charges. It is pointed out that in Ohio the United States Court refused to enjoin one telephone company from making any toll-line connections with another telephone company, the judge ruling that, under the public policy of the State of Ohio, an exclusive contract such as that which the application for an injunction sought to establish could not be granted.

Census Electrical Data.

Additional advance thirteenth census (1907) data on the manufacture of electrical machinery and apparatus, supplementing the tentative report issued in September last and printed in our issue of Sept. 9 are contained in a statement just issued by Census Director Durand in response to requests from leading technical journals and the principal manufacturers. The matter was prepared under the direction of Mr. William H. Steuart, chief statistician for manufactures, Bureau of the Census. The figures are preliminary and subject to such revision as may be necessary after further examination of the original reports.

	Number of Establishments Reporting.	Number.	Total Kilowatts.	Value.
Dynamos:				
Direct current	75	13,882	414,222	$4,711,000
Alternating current	28	2,909	991,728	8,370,000
Dynamotors, motor-generators, boosters, rotary converters, and double current generators	29	2,291	295,079	3,155,000
Transformers:				
50 kw and over	14	3,953	11,058,021	4,616,000
Under 50 kw	31	72,776	577,408	4,185,000
			Total horsepower	
Motors:				
Direct current for power	93	100,714	676,682	7,787,000
Alternating current for power	45	143,409	1,006,995	10,519,000
For automobiles	8	2,796	12,471	294,000
For fans	32	199,113	178,033	2,451,000
For electric elevators	22	4,988	63,585	1,189,000
For railways and miscellaneous, including parts and supplies	..	53,710	795,652	9,847,000
		Weight of Plates. (Pounds.)		
Storage batteries	68	23,119,331	....	$4,244,000
Parts and supplies	..	.....	....	434,000
		Number.		
Primary batteries:				
Liquid and testing	11	344,650	....	729,000
Dry	43	33,988,881	....	4,583,000
Parts and supplies	18	....	....	622,000
Arc lamps:				
Open	10	5,004	....	84,000
Inclosed	23	118,981	....	1,623,000
Incandescent lamps:				
Carbon filament	43	55,048,378	....	6,157,000
Tungsten	20	11,738,619	....	6,241,000
Gem, tantalum, glower and vacuum and vapor lamps	....	....	....	2,716,000
Decorative and miniature lamps, X-ray bulbs, vacuum tubes, etc	16	....	....	601,000
Telegraphs:				
Intelligence	6	83,539	....	198,000
Police	17	....	....	1,127,000
Wireless apparatus	23	....	....	448,000
Switchboards and telegraph parts and supplies	15	....	....	185,000
Telephones:				
Transmitters	27	1,116,403	....	1,377,000
Receivers	31	1,063,309	....	1,135,000
Complete sets of instruments not included in transmitters and receivers	52	732,697	....	5,104,000
Interior systems complete without instruments	12	16,238	....	123,000
Central switchboards	27	36,272	....	2,399,000
Private exchange boards	11	2,252	....	370,000
Parts and supplies	48	....	....	3,752,000
Electric heating, cooking and welding apparatus (1)	....	....	....	1,003,000
Electrical measuring instruments:				
Station apparatus	21	....	....	1,639,000
Testing and scientific	37	....	....	547,000
Meters for consumers' circuits	15	....	....	5,614,000

(1) Twenty establishments reported the manufacture of electric heaters including those for cars; thirteen, electric cooking stoves; and four, electric welding apparatus.

Meter Committee of N. E. L. A.

The meter committee of the National Electric Light Association was in session at the Hotel La Salle, Chicago, on Oct. 19 and 20, Mr. A. J. Bushnell, chairman, presiding. The other members of the committee present were: Messrs. W. H. Fellows, Washington, D. C.; W. E. McCoy, New York; Frank A. Vaughn, Milwaukee, and W. L. Wadsworth, Minneapolis. The first day's meeting was confined to the committee itself, but on the second day there was a conference with representatives of meter manufacturers, the latter including Messrs. F. G. Vaughn and F. P. Cox, General Electric Company; William Bradshaw, Westinghouse Electric & Manufacturing Company; Charles E. Hansell and A. G. Lucas, Duncan Electric Manufacturing Company; A. A. Serva and A. L. Pond, Ft. Wayne Electric Works; Chester E. Hall, Minerallac Electric Company; E. R. Anderson, Willis Electric Meter Company; H. W. Young, Sangamo Electric Company, and H. I. Shire, Columbia Meter Company. In addition there were two visitors of some note, Mr. John Nelson Cadby, of the Wisconsin Railroad Commission, and Mr. Ernest E. Sharp, of London, who is connected with Chamberlain & Hookham, meter makers, Birmingham, England. The latter happened to be visiting Chicago and attended the conference by invitation. Mr. A. G. Turnbull, foreman of meter repairs for the Commonwealth Edison Company, attended the meetings of the committee also.

Much important work has been mapped out by the meter committee, which will report at the Seattle convention of the N. E. L. A. next June. At the Chicago meetings there was a discussion of uniformity in the dial markings of meters, uniformity in meter connections and uniformity of design as affecting the price of watt-hour meters—all subjects of much interest to electric-service companies. The next meeting of the committee will be held early in December, probably, and Chicago is likely to be the meeting place. On the evening of Oct. 19 the committee took dinner at the Illinois Athletic Club and met President John F. Gilchrist, of the N. E. L. A., and some of the other officers of the Commonwealth Edison Company.

Project to Develop Falls of Ohio River at Louisville Revived.

Mayor Head, of Louisville, Ky., has revived the project to harness the falls of the Ohio River at that point and the local Engineers and Architects' Club has appointed a committee to investigate the feasibility of the plan. At a session of the club Oct. 16 many engineers present scouted the possibility of utilizing the changing flow of the river, which varies 30 ft. in height. The average head available at the falls is about 12 ft., but this almost vanishes during times of flood, while at low water the small quantity flowing would be of little value for power purposes. The average flow of 8000 cu. ft. per second in the river has been variously estimated to be capable of delivering 6000 hp to 50,000 hp, and plans for a power canal around the city have been proposed by the advocates of the scheme. Others have computed the interest on the heavy construction costs involved for this low-head development to exceed the saving to be expected over a coal-burning plant. In any case, it is pointed out, on account of the stream variations, which make a hydroelectric plant inoperable during flood and low-water conditions, an auxiliary steam plant would be needed.

At the Engineers' Club meeting Mayor Head, Mr. M. W. Neal, of the Board of Public Works; City Engineer David Lyman and Major Lytle Brown, local United States engineer, advocated the development of the falls. Messrs. T. A. Leisen, Marshall Morris and J. T. Gathright opposed the plan. At the close of the meeting the club's president, Mr. G. Wilbur Smith, chief engineer for the Louisville Lighting Company, appointed a committee to investigate the water-power plan, naming Messrs. Marshall Morris, D. R. Lyman, T. A. Leisen and Carl Clem as its members.

Keokuk Water-Power Development.

Mr. Hugh L. Cooper, vice-president and chief engineer of the Mississippi River Power Company, which is erecting a great hydroelectric plant on the Mississippi River at Keokuk, Ia., lectured before the Western Society of Engineers in Chicago on Oct. 18 on "Water-Power Development of the Mississippi River at Keokuk." Mr. Cooper also spoke before the St. Louis League of Electrical Interests and the Engineers' Club of St. Louis on the same subject on the evening of Oct. 19. The lecturer's address was illustrated by a large number of lantern-slide pictures and was greatly enjoyed, the speaker's straightforward manner and occasional flashes of dry humor making his remarks especially interesting. The address was mainly devoted to the hydraulic features of the undertaking, and in view of the illustrated article describing the present condition of the work which was given in the *Electrical World* of Oct. 21 it will not be necessary to make an extended report. A few facts brought out by Mr. Cooper will be of interest, however, as supplementing previous accounts that have appeared in the *Electrical World* and also correcting one or two inaccuracies that have appeared in print.

In view of the recent failure, or partial failure, of dams in Pennsylvania and Wisconsin, it is important to know that very careful precautions have been taken in making the foundations for the main dam at Keokuk. At distances of 36 ft. test holes have been driven to a depth of 36 ft. in the bedrock of the river in the middle line of the 4600-ft. main dam. Compressed air is forced down one hole and if there is any indication of escaping air or mud in the adjoining hole further excavation is made to discover the cause. The rock in the bed of the river is excellent for foundation work, and in only one instance has a defect been discovered by the careful testing adopted. This was a stratum of 4 in. of clay about 4 ft. below the surface, and the excavation was carried down below this weak spot.

The entire development at Keokuk will cost about $25,000,000. The interest charged on the money secured to carry on the work is nearly $3,000 a day, so that the necessity for all reasonable haste is obvious and great pains have been taken to expedite the construction work as greatly as is consistent with safety. About 1500 men are now employed on the job. The damages paid for lands which will be overflowed by the lake created by the dam amount to about $2,000,000. This lake will have an area of nearly 100 sq. miles, but will be of small value as a storage reservoir, because the development is a low-head proposition and the greatest necessity is to maintain a uniform head of water so that the storage supply cannot be drawn upon to a very great extent. About $1,000,000 has been spent in equipment for construction work.

As has been previously stated, a contract has been entered into to supply 60,000 hp of electric energy to the public utilities of St. Louis, 140 miles away. This contract is very elaborate. The base rate made for electrical energy delivered in St. Louis is $18 a hp-year at 60 per cent load-factor. However, by an interesting provision, it is agreed that there shall be a revaluation every ten years, made by arbitrators, if necessary, to fix anew the rate for electrical energy according to the fluctuation in the market price for coal for the average of a term of two years before the date of revaluation. The base rate for coal is taken as $1.42 a ton. For each increase or decrease of 1 cent in the price of coal a corresponding increase or de-

crease of one-half of 1 per cent shall be made in the price of the hydroelectric energy. Thus, if in ten years the price of coal has gone up 20 cents a ton, the price of the energy delivered in St. Louis will be advanced 10 per cent, making it at that time $19.80 a hp-year. Similarly, a reduction in the price of coal will mean a reduction in the price of electricity under the St. Louis contract, which is for a term of ninety-nine years.

It is of interest to note that the 7500-kw generators, of which fifteen will form the initial installation, will be probably the largest hydroelectric units in existence using one runner in the turbine. The rotor of each of these units weighs about 500,000 lb.

Mr. Cooper concluded his Chicago lecture by inviting the members of the Western Society of Engineers to visit the plant at any time, but preferably some time next spring. In the discussion Mr. Lyman E. Cooley, the well-known civil engineer, told in an interesting manner of his early connection with the work. Mr. Cooley made a study of the situation ten years ago, and his preliminary plans for water-power development at the rapids at Keokuk have been followed in the main in the present development. Mr. Cooley paid a high compliment to Mr. Cooper for his work, not only as an engineer, but as a financier, in securing the funds for the project after arduous and long-continued effort. In referring to this financial side of the project, Mr. Cooper said that bankers seem to have a distrust of engineers' preliminary estimates of cost, and there seems to be some foundation for this apprehension. Mr. Cooper advises his hearers never to make any estimate for anybody unless as a last resort and after exhaustive study. Temporary or preliminary estimates of cost are apt to be misleading and should be avoided by the engineer.

Denver Convention of Sons of Jove.

As published last week, the ninth annual convention of the Rejuvenated Sons of Jove was held at Denver, Col., Oct. 16, 17, 18. There was a larger attendance than at any previous annual meeting, probably because of the stirring contest waged by Mr. Washington Devereux, of Philadelphia, and Mr. Robert L. Jaynes, of Pittsburgh, for the office of Jupiter.

There was a short skirmish when the meeting convened on the day of election, but Mr. Devereux proposed the name of Robert L. Jaynes for Jupiter and the election was made unanimous. Mr. Jaynes has been one of the most indefatigable workers in the order and his friends look forward to great achievements under his administration. Among other matters that came up was a suggestion from Past Jupiter J. Robert Crouse for a fund to be created by the Past Jupiters' Association. In the absence of Mr. Crouse this paper was presented by Mr. Philip S. Dodd. Another matter considered was the advisability of accepting advertising in the *Jovian Bulletin.* It was decided to try the plan of taking advertising for a year, although the meeting was very much divided on the subject, it being felt by some that the dignity of the order was at stake.

The tenth Jovian Congress will be made up as follows: Jupiter, Mr. Robert L. Jaynes, 1421, Pittsburgh; Neptune, Mr. H. E. Hobson, 56, Dallas; Vulcan, Mr. George H. Porter, 194, Chicago; Pluto, Mr. H. C. Biglin, 1095, Denver; Mercury, Mr. E. C. Bennett, 3932, St. Louis; Hercules, Mr. W. M. Stearns, 2703, Atlanta; Mars, Mr. H. H. Cudmore, 196, Cleveland; Apollo, Mr. W. J. Grambs, 447, Seattle, and Avrenim, Mr. C. M. Parr, 1788, Hartford.

The Denver Jovians did everything possible to make the visitors' stay pleasant, comfortable and interesting. On Monday evening a smoker was held at the Traffic Club, and on Tuesday the rejuvenation was held at El Jebel Temple, at which about 100 new members were initiated. The rejuvenation was preceded by a parade through the principal streets and the electrical effects were beautiful, the Pittsburgh and Philadelphia floats being particularly good, these cities being the contestants for the next annual meeting. The contest was later decided in favor of Pittsburgh.

The attendance at the banquet on Wednesday evening was 300, and addresses were made by Jupiter Jaynes. Past Jupiters Turner, Hobson, Kirkland and Dostal and Mr. Washington Devereux. The two gentlemen last named were presented with loving cups.

Possible Combination of Elevated and Surface Railways in Chicago.

For some time a merger of the elevated and surface street-railway systems of Chicago has been under discussion. An important step in this direction came to light on Oct. 23, when a letter addressed to the Mayor and City Council of the city of Chicago was made public at a meeting of the City Council. This letter was signed by Mr. Henry A. Blair, representing the Chicago Railways Company; Mr. Ira M. Cobe, representing the Chicago City Railway Company, the Southern Street Railway Company and the Calumet & South Chicago Railway Company, and Mr. Samuel Insull, representing the Chicago Elevated Railways, recently combined, as already noted in this journal. The letter of Messrs. Blair, Cobe and Insull was short but significant. It reads as follows:

"To the end that a comprehensive plan be formulated, having for its purpose the permanent establishment and maintenance of the best possible transportation facilities for the city of Chicago, the undersigned will be glad to co-operate with your honorable body in an earnest endeavor to work out a satisfactory solution of every phase of the transportation problem."

This letter was dated Oct. 21, 1911, and was transmitted to the City Council by the Mayor with the recommendation that it be referred to the local transportation committee, which was done. The meaning of the communication, no doubt, is that street-railway and elevated interests are preparing to "get together," but before doing so wish the sanction of the city authorities, which is probably indispensable under the "traction settlement" ordinance of 1907 under which the surface-railway companies are operating. The proposed consolidation has also an important bearing on the question of building a passenger railway subway in Chicago. The interest of the Commonwealth Edison Company, of which Mr. Insull is president, in the situation is an active one, owing to the intimate relation of the head of that company with the elevated railways and also to the fact that the electric-service company supplies a large proportion of the electrical energy used both by the surface and elevated railway companies of Chicago.

Artificial Illumination in Continental Europe.

Under the title "Random Notes on Light and Life in Europe" Dr. Herbert E. Ives, of Cleveland, gave an interesting illustrated address before the Chicago Section of the Illuminating Engineering Society on Oct. 19. Mr. R. F. Schuchardt, the new chairman of the section, presided for the first time. Dr. Ives discussed interior lighting on the continent of Europe, considering both ancient and modern times and basing his remarks on observations and researches relating to a recent European tour. The famous structures of antiquity, such as the Parthenon and the Pantheon, were probably lighted by daylight exclusively, in some cases by openings in the roofs. Pompeiian houses

had no windows; the rooms were lighted from courtyards. Beautiful oil lamps have been found in Pompeii, but they could have been of little service for general illumination; perhaps they were carried about as lanterns are to-day. In modern Europe the street lighting is fairly good, but interior illumination is very poor, as a rule. The speaker saw only one example of modern illuminating glassware on the Continent. Europe may be the home of art, but there is more truly artistic lighting in this country than abroad, although that isn't saying much. In Venice the canals introduce an interesting problem in street lighting by reflections from the water; it is, in fact, as if the streets had mirrors for pavements; the lights are seen double. In conclusion the lecturer said that modern illuminating engineering has great fields to conquer on the continent of Europe.

Mr. J. R. Cravath inquired as to the practice of using very high lamp-posts for high candle-power flaming-arc lamps in Europe. He explained that powerful flaming arcs are to be used for a considerable amount of new electric street lighting in Chicago and that at last accounts the plans were to have these on posts only 20 ft. high. Many feel that this is a mistake for lamps of such high candle-power and distribution characteristics and that posts not less than 30 ft. high should be used for these lamps. He asked Dr. Ives as to the general illumination effect and also as to the appearance of such high posts as are used in Europe.

Dr. Ives answered that he had noted one place in Berlin where iron posts as high as 50 ft. have been used for flaming-arc lamps with good effect. The illumination is spread over a large area and the lamps are above the ordinary range of vision.

Mr. F. A. Vaughn, of Milwaukee, inquired as to the street-lighting conditions in London. Dr. Ives reported that there is considerable rivalry between different sections of London and remarks applying to one section as to lighting might not apply to another. While a considerable quantity of light is used on London streets in some localities, the lighting in London in general on the best streets is not up to that in this country, artistically, as compared with the best streets here.

Chairman R. F. Schuchardt asked for a comparison of the best streets of Berlin with the best lighted streets in Chicago and also asked as to the reported supremacy of the Germans in scientific investigations leading up to discoveries of new illuminants. Dr. Ives' answer in general was that in the scientific development of new illuminants Germany is in the lead, but that, once they are developed, the Germans do not make use of these illuminants intelligently. There are more high candle-power arcs in use there than in the average American city. The Germans do not use their new lamps either artistically or comfortably. They are far behind Americans in the use of reflectors and diffusing mediums for the reduction of annoying glare. Scientific reflectors are rarely seen in Europe by the casual observer.

Electrical Show at Salt Lake City.

The first annual electric show under the auspices of the Electric Show Association of Utah was held in the Central Block, Salt Lake City, Oct. 2 to 7. Over 2000 incandescent lamps were used in the street decorations in the form of festoons and streamers leading from Main Street to the show building, and a large electrically illuminated hand at the intersection of Main and Second South Streets directed the visitors. An electrically outlined kite was suspended between two buildings, with a streamer of electric lamps, representing the string, running from the kite to a large key in front of the building. A large blue bell, made up of electric lamps, which was furnished by the Mountain States Telephone and Telegraph Company, was suspended over the street and attracted much attention.

The main auditorium has a floor area of 100 ft. by 160 ft., and in the rear of this auditorium is a lecture hall in which Professor Plumb gave lectures and experiments on high-frequency currents. Thirty-three booths, each having a floor area of 156 sq. ft., were suitably arranged in the main auditorium. The decorations of the building were almost entirely in white, supplemented by autumn leaves and potted plants to add a little color. The lighting of the auditorium was done by festoons and clusters of tungsten lamps.

The east one of the two large show windows was fitted up to show the old-fashioned and the modern home, and the west window was given over to a display of the signal equipment of the Utah National Guard, a feature of which was a wireless telegraph equipment.

The Utah Light and Railway Company had an electric kitchen, in which it was shown by actual cooking demonstrations that it is possible to cook entirely by electricity by means of the electric fireless cooker and a few supplementary pieces of apparatus, at no greater cost than with coal or gas. In another booth was shown the development of street lighting in Salt Lake City, by means of a series of lamps, including the first Brush arc lamp installed in 1886, and each successive type, up to the present luminous arc lamp. An automatic tool-grinder direct-connected to an electric motor illustrated the possibility of the application of electricity to industrial work. An Edison storage battery and rack were shown with various sizes and types of incandescent lamps connected to meters, by means of which the relative consumption and illumination from the various types could be illustrated to the visitors.

The Telluride Power Company showed a large map of the lines and power plants of its system, with photographs of stations, pipe lines and transformation lines, standard and commercial instruments, and an oscillograph so arranged as to show the wave-forms of the voice, and an open-core transformer.

The list of exhibitors included the Mountain States Telephone & Telegraph Company, Intermountain Electric Company, Westinghouse Electric & Manufacturing Company. Progress Company, Stewart-Gleeson Company, Western Electric Company, Fairbanks-Morse Company, Mine & Smelter Supply Company, Studebaker Brothers Company, Wagner Electric Manufacturing Company, Utah Electric Supply Company, University of Utah, General Electric Company, Capital Electric Company, E. H. Eardley.

Turin International Electrical Congress—II.

Construction, Central Stations, Switchboards and Distribution.

In Section II of the Turin International Electrical Congress eleven papers were presented, dealing with construction, central stations, switchboard and distribution. Abstracts of part of these papers follow.

TRANSMISSION AND DISTRIBUTING SYSTEMS.

The selection of the transmission and distributing voltage and the design of switchboards and substations in large electric installations, taking into account both economy in first cost and continuity of service, were discussed in detail in a well-illustrated paper by Mr. Philip Torchio, chief electrical engineer of the New York Edison Company. The subject was discussed under the two heads of long-distance transmission and the selection of distribution voltage. Concerning long-distance transmission, the author concluded that in large installations the selection of the transmission voltage will be primarily governed by the difference between the saving in costs of lines and transmission losses due to higher voltages and the corresponding extra cost

of apparatus at the stations and substations; this cost will necessarily increase with the number and decrease in size of substations, so that where primary transmission lines are to be tapped for distribution at many points the extra-high-tension voltages may become economically impracticable. He stated that extra-high-tension systems are at least as reliable as lower voltage systems and in respect to protection against transient surges and lightning they possess material points of superiority. In important installations it is advisable to employ extra-high-tension insulation for lines and apparatus, even on lower working voltage systems, in order to raise their factor of safety.

The author claimed that the selection of distributing voltage is governed by the following four considerations: First, the relative cost of cables, which depends on the average length of feeders on the main system, and also upon the posible use of step-up transformers for the long feeders. Second, the relative power and energy transmission losses. Third, high-speed large-power generators require low-voltage windings for high dielectric and mechanical factors of safety. Fourth, the greater reliability of lower voltage systems is more valuable to important distributing systems, because of the greater commercial losses they would sustain in case of even momentary interruptions of service.

Three appendices formed an important feature of the paper. The first of these contained illustrations and descriptions of extra-high-tension switching gear and apparatus and typical designs of stations and substations. The second covered the continuity of service as shown in abstracts taken from operating reports of high-tension systems. The third dealt with steam generating plants, hydro-electric power substations and local transforming and distributing substations. Other features of the paper, which was also presented before the Spring Lake convention of the Association of Edison Illuminating Companies, were noted on page 862 of our issue for Oct. 7.

UNDERGROUND CABLE CONNECTED TO OVERHEAD LINES.

Mr. J. Grosselin submitted a report on high-tension underground cables connected to overhead lines. Assuming high-tension to include only voltages above 25,000, he finds that there are very few such installations now in operation, the highest tensions employed on cables at present being 40,000 volts alternating and 50,000 volts direct, although the Lorraine Electricity Company is planning to install 3 km of three-conductor cables to operate at 65,000 volts.

The practice of the various countries as to the factor of safety allowed in factory and installation tests was given, and it was recommended that the factory tests for alternating voltages from 25,000 volts to 50,000 volts be determined by multiplying the normal working emf by 2 and adding 10,000, and that for tensions above 50,000 volts the factor 1.5 be used. For direct emfs a factor of 1.25 was recommended. The proper duration of the factory test was set at fifteen minutes. At the end of the report there is appended a table giving various interesting data on high-tension cables operated in different parts of the world.

Mr. Grosselin's report was discussed by Messrs. Jona, Torchio, Soleri, Delon, l'Hoest Gevaert, Lichtenstein and Dunn.

THE CONSTRUCTION AND USE OF CIRCUIT-BREAKERS.

The present state of the art of automatic circuit-breaker design and application was set forth in a long paper by Mr. E. Ragonot. All circuit-breakers were divided into two main classes, namely, air-break and oil-break contacts.

Under the head of air-break switches the author discussed present practice and construction of the following details: Contacts, terminals, closing and releasing mechanism, arc extinction, inverse time-limit attachments, remote control. With respect to contact surface he declared that it was wrong to specify the current density, since it is the potential drop that is important, and in this type of switch he placed the upper limit of allowable drop across the contacts at 10 millivolts.

Early in the discussion of oil-switch design a sharp line was drawn between American and European practice. The American-type oil switch has the following distinguishing characteristics:

1. Two breaks per pole for the highest tensions.
2. Large range of motion of contacts (25 cm to 50 cm).
3. Small volume of oil.
4. Separate cells for even low tension.
5. Use of impregnated wood as insulating support to the movable armature.

On the other hand, the following characteristics serve to distinguish the Continental type:

1. Multiple breaks per pole (two to eight, according to the tension on the power).
2. Short range of motion (8 cm to 15 cm).
3. Large volume of oil.
4. Single cell for all poles of one switch for low and medium tensions.
5. Extensive use of porcelain as insulator.

With regard to contacts of oil switches, the allowable drop was placed at from 25 millivolts to 30 millivolts.

Under the head of "dimensions of oil switches" the author gives a digest of a report on the subject recently submitted by a committee of the German Society of Engineers. The latter part of the paper dealt with inverse time-limit relays, their construction and operation, and the last section is devoted to a discussion of the probable future of the oil switch. At the present time it is usual practice to overhaul a switch thoroughly after each operation under dead short-circuit, and if two such loads should be imposed in quick succession it is doubtful if the largest switches now made would be able to stand up and properly perform their functions.

To improve the action of oil breakers in this respect the author suggested the following expedients:

1. Quickest possible break.
2. A very large volume of oil.
3. High pressure on the oil.

He then follows this with descriptions of some of the latest experiences of the various large companies.

PARALLEL OPERATION OF ELECTRIC STATIONS.

This subject was assigned to Mr. Nizzola, but on account of severe illness he was unable to prepare a paper

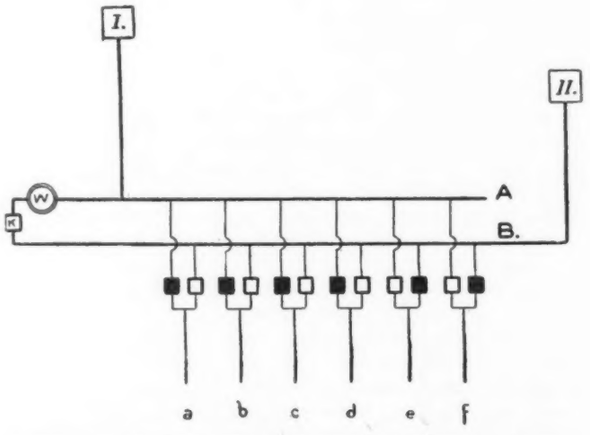


Diagram Showing Parallel Operation of Electric Stations.

and, therefore, Mr. Guido Semenza gave a brief description of a method of parallel operation used by the Edison Company of Milan, the idea being to start a discussion of the subject. A schematic diagram of the connections for two plants feeding six circuits is shown above. Plant I is

connected to bus *A* and plant II to bus *B*, the two buses being tied together through a wattmeter and a circuit-breaker. The wattmeter is equipped with an alarm bell. Each distribution circuit is provided with connection to each bus.

In explanation of the system the author assumes plant I to be rated at 4000 kw, plant II at 2000 kw and the load on each circuit to be 1000 kw. Then under full-load conditions four circuits are connected to *A* and two to *B*, and if a short-circuit occurs on lines *e* or *f* the breaker *k* will drop out and clear plant I from all trouble. Another condition which this arrangement meets very satisfactorily is the parallel operation of water-power and steam-power plants. For example, assume plant I to operate from water-power and plant II to operate from steam. During hours when the load is within the limits of plant I all circuits are connected to bus *A* and plant II is disconnected. When the load increases beyond the rating of plant I plant II is started and synchronized with I, the switch *K* being closed. The wattmeter indicates the amount of power supplied by plant II and the voltages can be so adjusted that the water-power plant will always operate at full load. When the load has increased sufficiently some of the lines are switched to bus *B*, the load being divided between the buses in proportion to the load it is desired to place on each station. The wattmeter enables the attendant to control the division of load and the circuit-breaker *K* prevents the spread of trouble from one plant to the other and thus limits the power behind a short-circuit.

The paper was discussed by Messrs. Torchio, Wyssling, Dübs and Del Buono.

ELECTRICAL APPARATUS FOR 100,000-VOLT CIRCUITS.

A paper by Mr. Stephen Q. Hayes contained illustrations and descriptions of some of the recent designs of 100,000-volt apparatus, in order to show the commercial feasibility of high-voltage energy transmission. The apparatus described included transformers, terminals, circuit-breakers, lightning arresters, station arrangements and transmission lines. It was stated that self-cooling transformers are being built in ratings as high as 3500 kva. Artificially cooled transformers are built in ratings as high as 14,000 kva. Although there is no inherent limit to the size of the transformer, it is not ordinarily advisable to construct them in ratings larger than 10,000 kva on account of the difficulty in shipment.

The construction of transformers for 100,000 volts presents no great difficulty, except as regards the terminals. With the so-called condenser type of terminal the difficulties have been successfully overcome. In this terminal the rod or tube forming the conductor is surrounded by a number of concentric condensers of predetermined capacity, arranged in such a manner that they are in effect connected in a series, so that the fall of electrostatic potential from the inner one, forming the line conductor, to the outer one, which is grounded, is such as not to strain the insulating material locally beyond its dielectric strength.

The development of a bushing with its capacity distributed in such a way as to insure uniform potential grading through the mass of insulation has greatly facilitated the design of high-tension switching devices. One-hundred-thousand-volt circuit-breakers are built for both indoor and outdoor service. For outdoor service the leads of the condenser type are covered with a series of porcelain insulators and the space between the bushing and the insulators is filled with a moisture-proof compound. The operating mechanism is covered by a metallic hood, and the pull rods connecting together the various poles of the breakers pass through pipes. Outdoor breakers of this design have been operated very satisfactorily on the lines of the Dominion Power & Transmission Company, near Hamilton, Ont.; the New York, Lockport & Ontario Power Company, near Niagara Falls, and the Southern Power Company in North Carolina.

The electrolytic type of lightning arrester has proved thoroughly reliable for 100,000-volt service. Where a somewhat cheaper form of lightning arrester is required for extremely high voltage on outdoor circuits it is possible to make use of a certain special arrangement, as has been done by the Southern Power Company. Instead of providing electrolytic cells placed in steel tanks, resistors are located in the circuit between the line and the horn gaps. The resistors are built up in the form of large columns having a large cross-section and great heat-absorbing capacity. Two columns are placed in series between each line and the ground connection. The resistors are made of a special mixture of concrete and red oxide of iron, and each column is divided up into a number of sections by expanded metal embedded in the cement. The edges of the expanded metal are riveted to sheet-metal eaves, which prevents water running down the sides of the concrete, thereby obviating variation in resistance due to the concrete becoming water-soaked. The arrester after having once been adjusted requires no attention and is so proportioned as to render it almost impossible for it to be seriously damaged by any discharge which can pass through it. The resistor column has a high resistance for low voltage and low resistance for high voltage.

Brief descriptions were given of apparatus built for potentials as high as 140,000 volts, which is the emf that will be used on a system to be installed in northern Michigan.

PRESENT LIMITS IN THE USE OF CABLES FOR ENERGY TRANSMISSION.

Mr. Elvio Soleri presented a paper dealing with the limits at present imposed upon the practical use of cables for long-distance transmission of electric energy.

To begin with, he gave a brief résumé of the present attainments in the art of cable manufacture and outlined the fundamental theories of cable calculations. In his investigation of the feasibility of using cables in long-distance energy transmission the author distinguishes three groups of limits, namely:

1. Limits imposed by manufacture.
2. Limits imposed by economy.
3. Limits imposed by safety of operation.

In the first group the author considered the emf and power that can be handled by three-phase and single-conductor cables, both for homogeneous and graded dielectric. He gave curves which served to determine the limits of section and emf.

The economic limits were studied by establishing relations between the price and power and emf of cables. The prices per kw-ampere were calculated for a series of cables of constant section and variable emf and for a series of constant emf and variable section.

In a special analysis of the use of aluminum in cables of very high tension the author gave some general results and some diagrams which permitted the determination of conditions under which this metal could be well adapted to cable construction.

Although long-distance transmission is usually cheaper with high-tension open lines, there were cited certain instances where cables might well be adopted. In studying the operation of cable lines it was shown that the capacity improved the efficiency of the line and that operation was more safe and reliable than with open wires.

The effect of capacity on economy formed the subject of a special study by the author, who, after giving the general relations, determined the losses in cable lines and open-wire lines and developed some simple formulas which express the laws of variation of these losses in terms of the constructive elements.

In conclusion the author stated that the present limits in the use of cables are far superior to the actual applications.

INVESTIGATIONS AND EXPERIENCES WITH HIGH-TENSION CABLES.

The results of a series of experiments carried on by the Siemens-Schuckert company in a system of high-tension cable manufacture were given by Dr. Leon Lichtenstein.

The chief object of these experiments was the determination of the losses of energy in single-conductor and three-conductor cables.

The first experiments were carried out upon 50-cycle, 700-volt, three-conductor, steel-armored cables, the conductors being in form of a sector and having an area of 310 sq. mm. The losses in excess of direct-current losses were as follows: 8 per cent in skin effect in the copper, 3 per cent in eddy currents in the lead cover and 8 per cent in eddy currents and hysteresis in the armor. Having foreseen that large single-conductor cables would leave very large losses in the copper and iron, some special tests were made upon a single-conductor cable having a section of 500 sq. mm and without armor. The diameter of the stranded copper conductor was 29.1 mm; the inside diameter of the lead sheath was 34.9 mm; the outside diameter of the cable was 40 mm. At 51 cycles per second the excess loss over direct-current losses was about 25 per cent and at 32.5 cycles it was about 10.2 per cent. It was practicably proportional to the square of the frequency and would therefore have been about 2.2 per cent at 15 cycles.

In consideration of the fact that high-tension systems employ single-conductor cables almost exclusively and that these cables often transmit large power over long distance, the great importance of the above results is apparent.

Following these tests the author made similar tests on single-conductor armored cables. These cables had a conductor section of from 35 sq. mm to 50 sq. mm with an insulation thickness of from 5 mm to 13 mm, and the armor was variously made of flat-steel strap, steel wire and copper wire. These experiments confirmed the author's expectations, since the hysteresis losses even at 15 cycles were so great as to limit seriously the use of this type of cable. For instance, it might be used for a short stretch, such as a river or a railroad crossing.

In conclusion the author called attention to a stretch of feeder cable between Bitterfeld and Dessau which has operated continuously for several months at 60,000 volts and 15 cycles.

GARBAGE DESTRUCTION AND ELECTRICAL ENERGY.

The destruction of garbage in connection with the production of electrical energy is the subject of a comprehensive report presented by Mr. Etienne de Fodor. Garbage destruction began in England, the first plant being constructed in 1870, and thereafter the practice spread very rapidly throughout the empire. The early plants were designed primarily to destroy garbage and little thought was given to any utilization of the heat thus liberated. In 1896 the city of Oldham built an electric power plant, 120 hp of which was derived from steam furnished by a garbage destructor. The first destructor plant that was designed expressly to enable the full utilization of the heat in the production of electrical energy was built in Shoreditch, London, and this plant was quickly followed by many more on the same order, and now there are 192 towns in England alone that have garbage destructor plants.

On the Continent the development of such plants has been slower, partly because the municipal authorities have often been prejudiced against them and partly because the heat value of the garbage is much less than in England.

The author discusses the variation of the quality of the garbage with the locality and the season of the year and gives actual figures from many different places.

Tests on thirty English plants are tabulated. These show an evaporation of water from 100 deg. C. to steam at 100 deg. C. of from 1.21 kg to 2.75 kg per kilogram of garbage, the average being 1.68 kg.

Similar tests from a number of different Continental plants show a general average of about 1 kg of steam per kilogram of garbage. Statistics covering the type of plant, the size, the electrical output and the uses to which the electrical energy is put are tabulated from information collected by the author from various English and Continental plants for the year 1910.

The statistical data are followed by a résumé of what is at present considered best practice in garbage destruction and utilization. First of all, if high efficiency is to be attained, arrangements should be made for storing the garbage and feeding it to the destructors at a uniform rate throughout the twenty-four hours. The electric energy would then be used to carry the peaks during periods of maximum load and at other times it would charge a storage battery from which the auxiliary apparatus of the destructor plant would be operated. The use of a storage battery is also recommended to care for the variations in steam production due to the constant variations in the heating value of the garbage. In some places boilers fired with coal or oil are used to care for these fluctuations.

It appears that in the past insufficient attention has been given to economy in the utilization of the steam. Better engines should be used and less energy should be employed in the operation of the plant itself. In some plants the energy consumed by the auxiliary devices constitutes 30 per cent of the gross output, while others require only 15 per cent. One instance is cited where by proper management the energy consumed in this way was reduced from 31.5 per cent to 17.1 per cent.

Another important phase of the subject relates to the utilization of the residue. This residue in the English plants often amounts to as much as 35 per cent of the total weight of the garbage, and in certain instances it may reach as much as 60 per cent. A number of plants have been equipped with a crushing outfit for handling this residue, the product being used in place of sand. It is well suited to concrete work, to the manufacture of brick and artificial stone, to the building of roads and in many other places where sand or gravel is now used. Comparative tests on concrete made with this residue and with gravel showed the residue to be fully as good as and in some instances even better than gravel for concrete work.

In connection with the location of a destructor plant it is interesting to note that there are no disagreeable odors whatever and that the location should be determined by purely economical factors, such as the ease of collecting garbage, etc.

The report concludes with a list of cities that have garbage destructor plants either in operation or under construction. The list is classified by countries. England heads the list with 192 plants; Australia, France, the United States and Germany come next with nine, eight, seven and seven respectively; South Africa has six and South America four; sixteen other countries are listed with from one to three plants each.

The 1911 Meeting of the British Association for the Advancement of Science.

The following is the conclusion of the report of the Portsmouth meeting of the British Association for the Advancement of Science. Other portions of this report were printed in the issues of Sept. 23 and 30.

Practically the whole of the morning of Tuesday, Sept. 5, was devoted to a discussion upon the relative merits of the "locomobile" type of superheated-steam engine suction gas engines and producers and Diesel engines, three papers being presented on the subject.

Mr. W. J. Marshall described the "locomobile" type of superheated-steam engine and related experiences with this

machine in ratings up to 500 hp. Tests reported showed a consumption of 1.21 lb. of coal per hp-hour by a 50-hp unit and a consumption of 1.24 lb. of coal per hp-hour by a 140-hp unit. The author expressed the opinion that this type of engine is more than able to hold its own against the competition of the steam engine.

Mr. W. A. Tookey presented a series of figures showing the actual performances of suction-gas power plants of various types and ratings. In the majority of tests mentioned the actual coal consumption by a combined set of engine and producer working with anthracite is between 0.70 lb. and 0.85 lb. per hp-hour. The units ranged in rating from 10 hp to 220 hp. The author expressed his belief that, in the near future, as in the years that have just passed, there is sure to be a great demand for the suction-gas engine and producer.

Mr. C. Day presented data tending to show that the "total works" cost of the kw-hour in stations where the plant rating does not exceed 1000 kw is 2.04 cents with steam engines, 2.08 cents with gas engines and 1.06 cents with Diesel oil engines. The average fuel consumption by Diesel oil engines in every-day service varies from 0.44 lb. per hp-hour at full load to 0.62 lb. per hp-hour at quarter-load.

There was a long discussion upon these three papers, the first speaker, Captain Sankey, calling special attention to the necessity for some definite pronouncement as to the meaning of "rated horse-power," a term used by all three authors, none of whom, however, gave a clear explanation of the method he adopted. The engineering standards committee some years ago had discussed this matter and decided, although it did not publish the recommendation, that the rated horse-power of gas engines, governing by missing explosions, should be 85 per cent of what the engine could possibly do.

Prof. W. E. Dalby expressed the opinion that the whole salvation of small steam plants is the superheating of the steam, and Mr. W. Y. Lewis asked whether it is possible to utilize the waste heat from Diesel engines in the same way that waste heat from steam engines is used. If this were possible, then the Diesel engine would have a larger field for power production in factories where the waste steam is at present used for heating purposes.

Mr. E. Kilburn Scott said that he would advocate the Diesel engine for any work that it could possibly perform and thought it was only a question of time before large Diesel engines would be built and displace the large steam-driven stations at present. One need only look round such stations as the Commonwealth station in Chicago to realize the inefficiency of steam. There there are six 20,000-kw units, with a large number of boilers. It was impossible to make the boilers large enough, and that is the limitation. He therefore hoped that the makers of internal combustion engines would increase their factories and carry out researches which would result in the manufacture of large Diesel oil engines.

Mr. H. E. Wimperis predicted the development of an internal combustion engine using steam and gas, to which Captain Sankey replied that such a proposition is now actually under his consideration.

Mr. H. S. Russell said that the reason why the Diesel oil engine has such low fuel costs is the very much higher thermal efficiency of the engine and the absence of stand-by losses. He mentioned a case in which a 500-hp gas-driven generating plant, in connection with which the fuel costs were 1.4 cents per kw-hour, had been replaced by a Diesel plant where the fuel costs were only 0.06 cent per kw-hour, a result which he attributed to the absence of stand-by losses. The fact that such a large amount of exhaust steam is obtained from steam engines only demonstrates their inefficiency. The over-all thermal efficiency of a steam engine is not more than 11 per cent; with gas engines it is from 1 per cent to 20 per cent, and with oil engines it is 40 per cent. Consequently the heat available as exhaust is less. At the same time, by means of a properly constructed boiler, good use can be made of the exhaust heat from Diesel oil engines. On the question of the reliability of oil engines, he mentioned an electric generating station in which such an engine has run for four years for twenty-three and three-quarter hours per day, while another on a battleship has run for 800 hours on one journey without stopping. By the elimination of the producer house or the boiler house, as the case may be, wages with a Diesel engine are reduced by half.

Prof. E. W. Marchant having called attention to the fact that all the authors of the papers had left capital expenditure out of account the president mentioned that it would be useful to have some further information on the comparative cost of generating electricity by the three methods.

In reply Mr. Marshall said that the superheated-steam engine which he had described was rated on the basis of allowing a margin above what it was known the engine would do. Thus, a 140-hp to 180-hp engine had the same guaranteed fuel consumption over that range and was guaranteed equally economical at either load. It was also guaranteed to give 200 hp with reasonably economical results. With regard to the question of producing electric energy, there are no electrical works driven entirely by these engines in England, but this is not true in Germany. He complained of the comparison made by Mr. Day, as it is possible that it may include steam engines twenty-five years old. Mr. Day should have made his comparison with a specified type of steam plant. The same thing applies to wages, which are naturally more on older steam plants owing to the more rapid deterioration. These are not legitimate comparisons to put forward, and he made a similar complaint against Mr. Tookey's figures. Mr. Tookey, he said, is very proud of some results with fuel at $1.92 a ton, but the tables showed that 75 per cent of the examples given burned anthracite coal and he submitted that internal-combustion engine makers did not make their case good by giving examples of this sort.

Mr. Tookey said that, unlike the other two authors, he is not a manufacturer. He merely collected the figures from the owners of the plant and gave them for what they were worth. He made no apology or excuse for them. It is the usual plan for gas-engine makers to rate their engines upon the maximum power that can be hoped for from an engine of any particular size after a run of fifteen minutes, thirty minutes or sixty minutes. Personally, however, he adopted the plan of taking the piston displacement, multiplied by half the number of revolutions and divided by four, which represents the rated horse-power of the engine. As a matter of fact the makers' figures usually agreed with these within 10 per cent.

Mr. Charles Day said that his firm rated engines at that load at which it was suitable to work continuously and there were many of his engines in actual service giving continuously the rated loads. They had been known to go to 10 per cent above that for two or three hours. With regard to the suggestion that his comparative figures were unfair, he replied that he had taken the figures from stations in Great Britain of the size he had mentioned, irrespective of their age, although, as a matter of fact, there are very few old engines in electricity works. He had not picked out special cases to suit his argument.

Three papers were left over for the final meeting of Section G on Wednesday, Sept. 6, the first being by Mr. E. Kilburn Scott on "The Manufacture of Nitrogen Compounds by Electric Energy."

Mr. Scott stated that the principal products obtained from the electrical fixation of atmospheric nitrogen are nitrate of lime, containing 12¾ per cent nitrogen, and calcium cyanamide, containing 18 per cent nitrogen. He described the processes for making nitrate of lime as car-

ried out at Notodden and for calcium cyanamide as carried out at Odda, Norway. He mentioned that calcium cyanamide is made in the following countries : Italy, France, Switzerland, Dalmatia, United States, Canada, Mexico and Japan, while in Germany alone there are about half a dozen factories. In discussing the possibility of manufacturing nitrogen products in Great Britain the author said that much depends upon the cost of energy. At Notodden the energy costs $7.92 per kw-year, or 0.09 cent per kw-hour; at Odda, $7.20 per hp-year is paid for energy. The author claimed that the time is ripe for the establishment of many electrochemical and electrometallurgical processes which at present are only carried on abroad. Among these the manufacture of nitrate fertilizers, and especially nitrogen compounds for explosives, is very important, especially the explosives, for use in case war should cut off the outside supply.

After President Ramsay had expressed himself in accordance with Mr. Scott's view that the English coal supply was at present sufficiently cheap to make it worth while considering this question and that the future of the country lay in having chemical works in the neighborhood of the collieries, Dr. E. Erkhardt, who is connected with the Badische and Birkeland-Eyde, said he disagreed with Mr. Scott that it is opportune now to establish works in Great Britain for the manufacture of nitric acid from the air. He was partly responsible for the introduction of the Birkeland-Eyde process into England, but could not agree that the time is now ripe for its full development there. After having entered into negotiations for land and having studied prices for energy the conclusion come to was that it would be better to wait at least for several months. After having experimented for some time with a 3000-hp plant at Christiansand a decision had been come to that the work could be more cheaply carried out there than at Ludwigshafen, where coal would have to be used. Notodden works are earning money, and at Ruckhardt, in Norway, a 250,000-hp plant is being erected, the first half of which will doubtless be at work by next summer. In view of the present state of development of these processes it has not yet been decided to adopt one to the exclusion of the other. At present four-fifths of the equipment in this station is operating on the Schönherr process and one-fifth on the Birkeland-Eyde process, but as the result of further experiments it is quite possible that these proportions will be altered later on. In order to maintain the supply of materials for the manufacture of explosives in time of war the British navy would have to protect the Chili saltpeter fleet, and if this were not in its power it would not appear that the navy could do much for the food supply of the country, which is a much more serious problem. However, he thinks that the British Admiralty does not take this view, and for that reason does not see any prospect of the government taking up any of these processes.

Sir William White supported the views of the author of the paper that encouragement should be given to the establishment of factories as suggested, and Mr. H. E. Wimperis called attention to the fact that three years ago, after investigation, he had arrived at the figure of 1,000,000 hp continually going to waste in Great Britain from blast furnaces and coke ovens. At that time he suggested a development similar to that now put forward, but in the only district where this waste energy is made use of, namely, on the Tyneside, where it is being utilized for ordinary electric generating purposes.

Mr. Scott, in reply, again urged that England is lagging behind in metallurgical processes and considered it eminently a case for government action, especially from the point of view of explosives. He recalled the fact that the manufacture of carbide of calcium was started a few years ago in a factory specially erected next to the works of the Yorkshire Electric Power Company, but the trust that controlled the manufacture of carbide of calcium and had headquarters on the Continent came to the conclusion that there were too many factories and shut the works down.

A paper on the possibility of fixing a new standard of smoke emission from factory chimneys was next read by Dr. J. S. Owens.

Dr. Owens described a telescopic apparatus for judging the density of smoke by comparison with a number of graduated smoke glasses.

The proceedings of this section were concluded by a paper by Mr. W. Y. Lewis, which described a new system of continuous transport.

Mr. Lewis gave details of the Adkins-Lewis system of rapid continuous transport. Use is made of a continuously revolving shaft extending throughout the whole length of travel of the cars, which are driven by spiral threads on the shaft. At the stations the pitch of the threads is such as to provide a low speed, but between stations the pitch is from six to eight times as large and the speed correspondingly higher. The author estimated that the total energy consumption per passenger-mile would be only one-eighth of the amount required in operating the present systems.

A tribute to the system was paid by Capt. H. Riall Sankey, who has inspected the experimental equipment at Ipswich and expressed his surprise at the small amount of power required and at the large amount of energy returned to the circuit by the retardation of the cars. He stated that he had experienced no difficulty in getting on and off the cars and that he could stand up easily while the car was accelerating and decelerating at the rate of 4.5 ft. per second per second. As an addition to his paper the author stated that in order to deal with traffic similar to that upon the District Railway, namely, 10,000 seats per hour, the spiral shaft would need to have a diameter of 2 ft. The efficiency of these spiral shafts was put at 90 per cent.

Before Section A (mathematical and physical science) on Monday, Sept. 4, Prof. N. E. Dorsey read a short paper on the work done at the Bureau of Standards on the absolute measurement of electric currents. Use was made of a balance of the type employed by Lord Rayleigh. Coils of square cross-section are wound bifilarly on enamel-insulated wire upon brass forms. A novel feature of the fixed coils is the provision in the forms and the back of the windings of a channel through which water can be pumped, so as to maintain the coils at a constant temperature. In this way the moving coil was surrounded by a double-walled jacket maintained at a constant temperature by water circulation. All portions of the instrument have been tested by means of a very sensitive astatic magnetometer and have been found to be good. The insulation of the coils has been excellent throughout the work.

On winding, the coils were carefully sealed with paraffin cloths and paraffin, and covered by a layer of softer wax, thus protecting the windings from changes in atmospheric humidity.

The distance between the two fixed coils was always such that the sum of the forces which they exerted upon the moving coil was a maximum. Under this condition a maximum force for a given current depends solely upon the ratios of the diameter of the moving coil to those of the fixed coils. Consequently the actual distance between the fixed coils need not be measured. This has a great advantage.

The ratios of the diameters of the coils were ascertained by a modification of the electrical method used by Lord Rayleigh. The settings of the coils and the needles were adjusted by electrical methods and the variations in the diameters produced by variations in the temperature and in the load carried were carefully studied experimentally. It has been found to be practicable to obtain such accuracy in the measurement of the ratio of the galvanometer constant of such coils that the mean variation from the mean of 10 or more shall amount to 2 in 1,000,000.

The correct adjustment of the coils was determined elec-

trically, and an electrical method was devised for detecting and correcting any slight error that might exist in the spacing or in the coaxiality of the fixed coils. The horizontality of the coils was tested by means of delicate jewels.

While the earlier results were more erratic than the later ones, they gave the same mean value. However, the conditions under which they were obtained were much less satisfactory than those secured later, and consequently only the later values have been considered in obtaining the final conclusion.

These observations give the following mean value for the emf of the mean Weston normal cell (as defined at the Washington conference) at 20 deg. C. in terms of the international ohm and the Bureau of Standards balance, namely, 1.01822 volts. This value differs from that obtained at the National Physical Laboratory by 4 in 100,000.

Whether this represents a real difference in the results given by the two balances or is an actual difference in the emfs of the reference coils used it is impossible at present to decide.

The instrument was designed by Prof. E. Rosa and the entire work was done under his strict supervision.

Discussion of Illumination by Pittsburgh Section, A. I. E. E.

The monthly meeting of the Pittsburgh Section of the American Institute of Electrical Engineers was held in the auditorium of the Engineers' Society of Western Pennsylvania on Tuesday evening, Oct. 10.

The subject of the evening was "Industrial Illumination as Applied Particularly to the Iron and Steel Industry."

The principal speaker of the evening was Mr. C. J. Lundo, who had discussed the same subject before the Association of Iron and Steel Electrical Engineers at its convention in New York City on Sept. 29, 1910, as mentioned in the *Electrical World* on Sept. 30.

The author covered the ground of steel-mill illumination very thoroughly, outlining two methods by which illumination may be determined for any given installation. An interesting fact is that, though illumination was one of the first practical applications of electricity in steel mills, yet advance along these lines has been very slow, probably due to the larger and more important motor-service problems engrossing the attention of the engineers and partially to the inflexible units of illumination in use.

The 9.6-amp series-arc lamp is still in use in many mills, but as series circuits are now being confined for sake of safety to outdoor work this type of lamp will undoubtedly soon disappear. The lamp most widely used to-day in steel-mill work is the standard inclosed-carbon arc of the 5-amp, 125-volt or 2.5-amp, 250-volt type. It has often been used indiscriminately for various purposes and has proved satisfactory, but owing to its comparatively low efficiency is giving way gradually to the more efficient types.

The advent of the flame-arc lamp a few years ago, though having a short life, called the attention of engineers to the importance of economy in illuminants. These high-power units were often misused in places requiring a less intensity of illumination, but frequently found a place for themselves in lighting large, high buildings or yards, resulting economically because of the large area to be lighted.

This lamp is now operated inclosed, the position of the electrodes have been changed from inclined to vertical, and it is available as a long-burning lamp.

The multiplicity of types of illuminants now available for different needs makes the problem of the illuminating engineer a difficult one. A table was given showing the relative values in lumens per watt of the various types.

The author gave two methods of predetermining illumination results and advocated their joint use until more reliable data are available for steel-mill work.

The simplest one is the flux method, by which the number of lamps is determined by a formula expressed in terms of watts per lamp, area to be illuminated, intensity of illumination desired, total watts used, a depreciation factor and a constant.

The factor of depreciation must be added to take care of the depreciation in candle-power from its initial value which occurs in all forms of illuminants to a certain extent. The number of lamps having been determined, the units are placed with a view to uniform intensity at all points and as few shadows as possible. This method has the limitation that except when accompanied by rules for height and spacing it affords no guide to the uniformity of intensity, and hence the desirability of employing also the other method, thus preventing uneven intensity, shadows and glare.

The second, or point-by-point, method is based on the use of illumination curves and is a quite simple, although somewhat laborious, method of determining the height and candle-power for a given result. The illumination curve is calculated from a candle-power curve showing values every few degrees in a vertical plane through the center of the lamp. After obtaining the curve the illumination intensities thrown by the lamp on the plane to be illuminated are calculated by means of a formula involving the intensity, candle-power and distance of the source of light from the plane.

Experience with the point-by-point method soon enables one to become familiar with certain facts regarding the height of lamps and intensity of illumination.

It is advisable in calculating the illumination to lay out a floor plan of the building which can be scaled, showing machines so that shadows can be determined.

Satisfactory illumination does not always consist in an abundance of light. Too much light is often objectionable because it makes the less intensely illuminated spots too dark by contrast and the eye has difficulty in following the change. The following are given as prime requisites when laying out an illumination plan:

(1) Intensity.

(2) Freedom from shadows where they are objectionable.

(3) Freedom from glare.

Frequently in steel-mill work sufficient illumination is received from the molten metal to obviate the use of any other illuminant, though safety committees are now insisting on some lamps being placed at these points for safety of the workmen. Intensity of a desirable uniformity can generally be secured by spacing and by the use of a proper candle-power size for a given height of hanging.

Shadows are not always objectionable, as by their contrasts the outlines and details of an object are often brought out clearly. They do, however, often lower the efficiency of an installation and can be controlled to a large extent by the location and multiplication of the outlets.

In places where bad shadows are likely to ensue unless outlets are spaced closely it is much cheaper to multiply low-cost, low-candle-power units than high-cost, high-candle-power units.

Glare or dazzling light fatigues the eye and causes irritation and if continued will injure the eyesight. It may be obviated by hanging brilliant lamps high, by the use of diffusing glassware or shades, by making the illumination uniform and reducing the shadows.

The incandescent lamp, on account of its low cost, small units, ease of operation and other well known inherent advantages, finds a useful field of application in steel-mill work, particularly in high-studded shops where high-power units would cast objectionable shadows.

The electrical committee of the Carnegie Steel Company has selected the medium efficiency (of the three efficiency ratings) for tungsten lamps, basing its decision on the necessity of having a minimum variety of lamps and also on the fact that an average life of 1300 hours is being obtained at this efficiency in a number of its plants.

The various arc lamps, including the flame and luminous types, are being used extensively, each having its own field of application.

Mr. B. R. Shover, of the Carnegie Steel Company, who was elected president of the Association of Iron and Steel Engineers at the recent meeting in New York, discussed the paper at some length. He said that one particularly good thing about the paper was that it gave a reasonable method of computing the lighting values of the different types of illuminants. Previously the manufacturers have based their values, some on mean spherical candle-power, some on one particular zone; these being correct only when all of the light emitted was used, whereas some of the light is always wasted.

The only safe method is actually to lay out a plan of the building to be illuminated and use the flux method, or the point-by-point method, or a combination of the two, which will determine the number of lamps to be used. It should be borne in mind that illumination figured for one shape of building will not necessarily be correct for another one of the same area, as the different-shaped room will require a different number of lamps. Having determined the number of different types required, then it is only necessary to multiply this by the first cost and the operating expenses to find the cheapest method to use.

Estimates based solely on photometric curves are often unsatisfactory. If they are not correct the calculations are valueless. If they are accurate then the deductions can be relied on. The speaker made a vigorous plea for the manufacturers to furnish curves representing average conditions in every respect. The curves should not be taken from one lamp, one electrode or one plane, but with enough lamps, electrodes and through enough planes to get a good average result—one that could be relied on. For each constant-potential arc lamp there is one voltage at which it gives the best results. Any variation from this gives different illuminating results and, therefore, curves should be given that show results from an average operating voltage between limits of 10 per cent to 15 per cent on each side of normal. No lamp gives the same amount of light during its life, so that the average amount during its life or renewal of electrodes should be given instead of the initial value.

Curves should also be prepared, said Mr. Shover, showing light by taking into account what is termed "inherent depreciation," or that due to deposits on the inside of the globe, not that due to dirt on the outside. This is purely a laboratory problem and should be done by the manufacturers, and two of them are doing it. Such data should also be compiled from average results. "Acquired depreciation," or that due to accumulation of dirt on the outside, is due to the location of the lamp. This data should be prepared by the operators, as they are the ones properly situated to get such information. The inherent distribution is very materially affected by the shape of the globes and reflectors. The accumulation of dust also affects this; in some cases it actually assists by aiding the reflection, but in others, of course, it is a menace.

To sum up, then, the customer demands from the manufacturer: (1) Average light through 360 deg. and the authority for the test. (2) Rate of inherent depreciation. (3) Difference in light due to variation from normal terminal voltage.

Illuminating engineering is comparatively new and the value of the data accumulated has not been recognized before. It is now, however, distinctly the duty of the manufacturers to give the data freely and accurately. The user and the maker should see the importance of demanding and giving respectively all accurate information possible.

A paper prepared by Mr. C. B. Auel, assistant manager of works of the Westinghouse Electric & Manufacturing Company, was read by Mr. E. P. Van Kirk. Mr. Auel stated that previously the scope of the illuminating engineer was limited owing to his having only the open-arc and the carbon-filament lamp, with a big gap between them, to choose from. Now, however, there is a large assortment filling in the gap and the selection demands careful consideration.

The art of illumination has developed into a science and practically all that is now known has been learned in the last five years. The public is still unaware of the vast amount of scientific knowledge that is being applied to illumination.

The illuminating engineer seeks to find the best method adapted to each case, bearing in mind the total economy to be derived, which after all is the most difficult to determine.

An interesting point brought out by Mr. Auel was the increase of efficiency in the workmen, expressed in minutes per day gained, by having satisfactory illumination on their work. An increase of two minutes per day per workman in a large shop would soon pay for the investment for good lighting.

A manufacturer would often spend thousands of dollars for machine tools and then seriously limit the output by failure to furnish proper illumination. The arrangement for controlling the lamps is often neglected, although it is very important, particularly from an economical operating point of view. An efficiently designed illumination system may be marred by injudicious arrangement of switches, thereby causing lamps to be lighted when they are not needed. It is the duty of the illuminating engineer to overcome this defect .

Campaign Against Proposed Municipal Plant in Cleveland.

An ordinance providing for the issue of $2,000,000 bonds for the purpose of furnishing funds for the construction of a municipal electric lighting plant will be submitted to the voters of the city of Cleveland on Nov. 7. The city has at present two small plants in outlying districts. These were constructed originally by small suburbs which were annexed afterward to the city of Cleveland. The general proposition now is to abandon these plants and to construct a new plant, presumably in some other part of the city, to engage in street lighting and commercial business.

The proposed issue of bonds is one of the principal questions of the campaign which is now under way in Cleveland. The Democratic candidate for mayor, Mr. Newton D. Baker, is strongly in favor of the proposal to issue the bonds and construct a plant. The Republican candidate, Mr. Frank G. Hogen, has stated that if he is elected he will make a careful investigation to determine the merits of the question of extending the existing plants.

For the purpose of presenting the facts regarding the situation to the public the Cleveland Electric Illuminating Company has issued various circulars and is now publishing a series of large advertisements in the daily newspapers. These advertisements will be continued during the remaining days of the campaign. The circulars are distributed each night at the various political campaign meetings held in tents in different parts of the city.

In the first newspaper advertisement addressed to the voters of Cleveland the company stated that the proposed increase in public debt was not a political issue, was not a question to be decided on the statements published in the

columns of a newspaper committed to the project, was not a question whether the company could be injured by the bond issue, but that the question was whether the additional debt and the consequent increase in taxes would be a benefit or an injury to the residents of Cleveland.

In the second advertisement the company took up a charge that its profits were excessive. The following figures were quoted: Outstanding bonds and stock on Jan. 1, 1911, $10,634,500; net earnings for the year 1910, $843,428; paid to bondholders and stockholders, $669,774. This amount is equal to 6.3 per cent on the outstanding capital. The difference between the net earnings and the amount paid to security holders, $173,654, represented the year's surplus, which was set aside to provide for contingencies. The advertisement stated further that the outstanding capital on Jan. 1, 1911, did not exceed the cost of the property on that date.

In the next advertisement the company took up the subject of "Capital and Real Value." Where its capitalization on Jan. 1, 1911, was $10,634,500, the value placed on the property by the Tax Commission of Ohio on the same date was $11,375,000. Since Jan. 1 an additional $2,400,000 has been invested in a new power house and extensions of the distribution system. The advertisement adds that there is not a public-utility company in the United States which is capitalized more conservatively than this and that the cost of duplication by the city will exceed the company's investment.

In a discussion of its rates printed in another advertisement the company reproduced a bill which had been published previously by a newspaepr. The newspaper desired to show that the rates were excessive. The bill showed a total use of thirty-three units at an average rate of 6.8 cents.

The company then inquired why $2,000,000 was hit upon as the sum needed for the proposed municipal plant. It stated that this sum would not build a municipal plant sufficient to supply even the downtown district.

In another advertisement the company took up the claim that the cost of electricity in the proposed power house would be but 1 cent a unit. To show that the cost at the power house was only a very small part of the total cost of production and distribution the company took up the report of the municipal water works, which showed that water delivered to Cleveland homes cost over eight times what it cost to pump it at the station. In a subsequent analysis of the operation of the water plant the company showed that the cost to the consumers was eleven and one-half times the cost to the city at the pumping station.

It was emphasized in an advertisement published on Oct. 15 that if the proposed plant was to supply all sections of Cleveland it would have to duplicate the present system of the Cleveland Electric Illuminating Company and that that could not be done without duplication of the investment of the company. An advertisement published on Oct. 16 discussed a charge made in a Cleveland newspaper in regard to financial operations of the company and stated that most of the statements made were either false or misleading. It added that adequate protection was given to the people through the absolute regulation of the company by the Public Service Commission of Ohio. Another advertisement stated that the absence of the important personal factor in municipal operation results in waste and extravagance.

Attention was called in one advertisement to the present debt of the city of Cleveland, which is so great that the city is unable to increase the rate of pay of the police force or increase the number of police and is unable to give the school authorities the amount that they say is needed. It has also been shown that some of those who are in favor of the proposed bond issue have referred to the plant as an "experiment." On Oct. 22 an advertisement was published which discussed the subject of "corporation-baiting" and showed that the articles prepared by the company had been offered to one newspaper at its regular advertising rates and publication refused. This paper favors the plan to issue the bonds and construct the plant.

One of the circulars issued by the company stated that since April, 1912, the interest-bearing debt of Cleveland had increased more than 100 per cent. The tax rate, now $1.36, must be increased to over $1.41. Next year, to meet sinking fund and other interest charges, other bonds already authorized will raise the rate to $1.46. Interest and sinking fund requirements on $2,000,000 lighting-plant bonds would raise next year's rate to nearly $1.50, the limit of the law, leaving nothing for other improvements.

Another circular discussed the cost of electricity in the home and declared that the average price obtained for all electricity is 6½ cents per unit. It is stated that a larger percentage of homes in Cleveland have electricity than in any other large city in the United States.

A circular which was issued on Oct. 24 gave twenty-eight facts in relation to the situation. These dwelt in part with the record of loss of the small municipal plants at outlying suburban points, which were operated by the city after annexation of the communities in which they were located. It also showed that municipal light plants cannot be regulated or controlled. There is no provision in the Public Service Commission law of Ohio for the regulation by the commission of municipal plants of any character. Privately owned plants are subject to strict regulations.

National Civic Federation to Study Public Utility Regulation.

The executive committee of the department on regulation of interstate and municipal utilities of the National Civic Federation met in New York City on Oct. 25 and made provision for an exhaustive investigation of the problems of which this branch of the federation has cognizance. Mr. Emerson McMillan, of the American Light & Traction Company, acted as chairman of the meeting, which divided the work to be done among a number of sub-committees, which will respectively have cognizance of rates, control of service, control of capitalization, franchises, accounts and reports. A sub-committee was also appointed to draft a model bill. The general question to be studied is "What is adequate regulation of municipal utilities, railroads, telegraph and telephone companies, both interstate and intrastate?"

Among those connected, directly or indirectly, with the electrical industry who will take part in the work outlined, are the following: Messrs. Theodore N. Vail, president American Telephone & Telegraph Company; George B. Cortelyou, president Consolidated Gas Company, New York; Samuel Insull, president Commonwealth Edison Company, Chicago; James H. McGraw, president McGraw Publishing Company, New York; W. W. Freeman, general manager Brooklyn Edison Company; Charles L. Edgar, president Boston Edison Company; W. J. Clark, General Electric Company.

The organization of this department of the federation follows the comprehensive investigation into the relative merits of public and private operation of public utilities both in this country and in Europe made some time ago by a commission of the federation. That commission unanimously declared for adequate regulation by a competent authority, with power to require for all public utilities a uniform system of records and accounts, giving all financial data and all information concerning the quality of service and the cost thereof, which data should be published and distributed to the public like other official reports; and it also recommended that no stock or bonds for public utilities be issued without the approval of some competent public authority.

Public Service Commission News

NEW YORK COMMISSION.

A hearing took place on Monday, Oct. 23, before Commissioner Maltbie, of the Public Service Commission for the First District, on the complaint made against the New York Edison Company by various organizations of stationary engineers who protested in a petition filed with the commission against the low rates the company gave to large users of electricity. Counsel for the New York Edison Company stated that the rates specified in the petition were in accordance with the schedule of rates filed with and approved by the commission and denied the allegations that energy is sold in some cases at less than cost. Counsel for the complainants asked that the commission make a full investigation to determine the assets of the New York Edison Company in order to ascertain the fixed charges entering into total cost of production. He cited as a precedent the revaluation case of the Menominee & Marinette Light & Traction Company before the Wisconsin Public Service Commission which ordered an increase in rates to large power users and lowered those for residential and certain business lighting after exhaustive investigation. [*Electrical World*, Aug. 19, 1909.] The practice of the commission of affording every opportunity to a complainant to present his case and submit material evidence was outlined by the commissioner, after which counsel for the complainant asked for postponement in order to obtain evidence to substantiate certain information relative to the charges, which had been conveyed by hearsay. The case was adjourned until 2:30 p. m. Wednesday, Nov. 1.

The Public Service Commission for the First District of New York has authorized the Bronx Gas & Electric Company to issue $80,000 5 per cent bonds, payable July 1, 1961. These are secured by a mortgage filed July 1, 1910, under which $692,000 in bonds has been issued. About $90,000 bonds is outstanding under an old mortgage.

The Public Service Commission, Second District, has closed upon its records the complaint of the residents of the village of Warwick, Orange County, against the Warwick Valley Light & Power Company as to service and rates. As a result of negotiations conducted by the commission, a new schedule of rates acceptable to complainants has been adopted by the company, effective Oct. 1, 1911.

OHIO COMMISSION.

The Ohio Public Service Commission has stated that no consolidations of telephone companies will be permitted until the valuations of the properties involved are listed, confirmed by official inquiry and approved by the commission. Attorneys for some of the companies have contended that the commission has no authority to make appraisements where there is an agreement for the exchange of business between the companies proposing arrangements that do not amount to absolute elimination of competition. This refers to cases where either the Bell or Independent interests purchase local exchanges and enter into an agreement to give the other company the long-distance business. The commission holds that in the event that absolute authority to appraise properties is not given by the new law it is empowered specifically to approve or disapprove of the consolidations or mergers. This amounts to authority to force the companies to yield where valuations are demanded by the commission.

MARYLAND COMMISSION NEWS.

The Maryland Public Service Commission has granted to the Highland Telephone Company, of Hartford County, Maryland, permission to sell its property in Pennsylvania to the Delta Telephone Company for $30,000. The price originally agreed upon was $34,000, but at the suggestion of the commission it was reduced to the figure stated.

Chairman Ambler last week stated at a public hearing upon telephone rates that the commission had about made up its mind that the unlimited telephone will have to go. At the hearing Mr. H. W. Rowland said that he had five telephones in different sections and had a different contract for each one. Mr. Francis I. Mooney registered a complaint about permitting the telephone company to act as the arbiter when a subscriber claimed that he had not made as many calls as the company claimed he had, and he suggested that the Public Service Commission act as arbiter. If the company is not willing to do this the commission should insist upon some mechanical system which will measure the calls. Mr. Benjamin E. Hartogensis complained of the charge of $2.50 for moving his telephone, saying that the time put in by the men and the material used were not worth more than 50 cents, or $1 at the most, the workmen remaining in his office only fifteen minutes. He also expressed himself as in favor of measured service and contended that the price of $6 a year for an extension station is exorbitant. Mr. E. D. Loane, Jr., said that if the telephone company had paid Messrs. Jackson for getting up the report it could not have been more favorable to the company. He contended that the report should give the details of the financing of the company. Mr. W. C. Dorsey said that he had a hard time getting an unlimited 'phone and when he did get it he was charged $5 for mileage, which he did not pay, and the company now threatens to discontinue the service.

First Vice-president F. H. Bethell of the Chesapeake & Potomac Company, at the request of Chairman Ambler, assumed the rôle of explainer and recited in detail many of the methods pursued by his corporation in the conduct of its business. A considerable portion of Mr. Bethell's discourse had to do with the coin-box 'phones in use in the district served by the Wolfe and Gilmore exchanges. He told of the company's devices for recording calls and the methods adopted to insure accuracy, including reference to the adjustment bureau, which hears complaints and adjusts differences. With respect to the coin-box 'phones Mr. Bethell, after saying that they had been installed as an experiment after the big fire of 1904, asserted that the experiment had not been especially successful. The average use of these 'phones, he said, amounts to something over one message a day and the annual revenue derived therefrom averages about $15 each. All told there are about 6300 coin-box telephones in use in the city and Mr. Bethell was strongly of the opinion that the company would not be justified in increasing the number. He said that it required an average of four seconds to secure a connection over an ordinary telephone, while the coin-box telephones usually require about seven seconds to complete a connection. Their use is an additional expense to the company, as operators can handle fewer lines. Replying to the allegation that the company in many instances charges for more calls than are used, Mr. Bethell said that, with its device for keeping tally, the probabilities are that the company, on the whole, loses something like 1½ per cent of its calls and that there is far more danger of an operator forgetting to charge a call altogether than there is of the call being charged for a second time.

The Consolidated Gas, Electric Light & Power Company, of Baltimore, submitted last week to the commission a compilation of the inventories of its physical property as requested. Piled up the documentary evidence exceeds 2 ft. in height. In complying with the request of the Public Service Commission the company's officials write that they could not have furnished the mass of data had the company not begun the work voluntarily over a year ago. The letter goes on to say that the company presumes it to be the intention of the commission to consider the value of the property and investments in so far as such value may be a factor in determining the fairness of the company's rates for service. Such a valuation consists of two divisions—the physical and the intangible, or going, value of the property. The physical value is then de-

scribed, while in the going value are included the cost of organization and the cost of developing the business. New public-service plants, it was stated, have seldom in the past yielded a return on the investment during the early years of operation. The history of the gas industry and of the electric industry shows clearly that such properties have not reached a position of profit-earning until many years after their construction. During the earlier years a large amount of money is required for development purposes. When a corporation is earning less than its operating expenses, interest and depreciation a deficit results and the stockholders are forced to make sacrifices to meet such conditions. These deficits, together with the discounts on the issue of certificates, constitute a large part of the cost of building up the business. A public-service corporation is entitled by law and equity to a reasonable return upon its investment. If the rates fail to produce sufficient revenue the investor is not receiving that return to which he is entitled. If he has received a reasonable return each year on his investment from the beginning of the enterprise, he has received that to which he was justly entitled and the value of the property is represented by the actual amount he has invested in it. If, on the other hand, the investor has failed to receive each year that amount which constitutes a fair return, he should be permitted to charge rates sufficiently high to reimburse him for early losses, or such losses should be considered as costs of developing the business and their addition to the physical value of the property should be permitted. Such additions, together with the organization expenses and discounts on the sale of securities, should equitably constitute the going or intangible value of the public-service company's property. The company asks that it be permitted to give any further information bearing on the issues involved in the course of the investigation. Attention was called to the fact that inventories submitted in the electric division include the property of the Baltimore Electric Company and the Roland Park Electric & Water Company. A separate physical valuation is being prepared of the Baltimore Electric Company based upon the property as it existed at the date of the lease, together with all the amounts expended upon it between that time and June 30, 1911.

CANADIAN HYDROELECTRIC COMMISSION.

Hon. Adam Beck, chairman of the Toronto Hydroelectric Commission, has issued a statement showing that, while the total estimated cost of building transmission lines for the commission was $4,006,927, the actual cost was $3,921,167, including all interest charges up to Nov. 1. At present twenty-eight municipalities are supplied with electrical energy on contracts aggregating 33,000 hp. It is estimated that 19,470 hp of this total will be used in 1912, which will produce a revenue to the commission of $463,828.

CURRENT NEWS AND NOTES.

ELECTRIC LIGHT MARKS CENTER OF UNITED STATES POPULATION.—The Showers Manufacturing Company, Bloomington, Ind., upon whose grounds the center of population of the United States is located according to the last census, has erected to mark the point a steel flagstaff 75 ft. high, upon the end of which is mounted a 120-cp electric lamp.

* * *

NATIONAL DISTRICT HEATING ASSOCIATION.—A meeting will be held Nov. 8 at the Cadillac Hotel, Detroit, Mich., by the executive committee of the National District Heating Association, in order to fix the time and place of the fourth annual convention of the association and to arrange for its program. Mr. D. L. Gaskill, Greenfield, Ohio, is secretary of the association.

STURGIS (MICH.) MUNICIPAL PLANT.—The town of Sturgis, Mich., held a public celebration on the completion of its municipal hydroelectric plant. The dam on the St. Joseph River and the big lighting plant will cost, it is estimated, $250,000. It is proposed to transmit electrical energy to neighboring towns for electric light and power purposes.

* * *

VON HELMHOLTZ BUST PRESENTATION.—An excellent bronze bust of Helmholtz having been presented to the American Institute of Electrical Engineers by Mr. Edward D. Adams, a public acknowledgment of this valuable gift to the historical collection of the Institute will be a feature of the Institute meeting in New York Nov. 10, 1911. It is expected that Mr. Edward D. Adams, the donor, will be present at this meeting and arrangements have also been made for an address in behalf of the Verband Deutscher Electrotechniker by Dr. Adolf Franke, who is at present in this country, and who was a student under Von Helmholtz.

* * *

MILWAUKEE SECTION OF N. E. L. A.—A successful and enthusiastic meeting of the Milwaukee Company Section of the National Electric Light Association, composed of employees of the Milwaukee Electric Railway & Light Company, was held in the Public Service Building in that city on Oct. 19. Mr. O. M. Rau, the chairman of the section, presided, and nearly all of the 125 members were present. Mr. Egbert Douglas, commercial engineer of the company, read a carefully prepared and exhaustive paper entitled "Some Considerations Involved in Selling Light and Power." The paper provoked a lively discussion, those taking part being Messrs. C. N. Duffy, C. Boose, Theodore Wisendanger, D. MacNaughton, J. M. Bolton and the author of the paper.

* * *

TELEPHONE RATE REDUCTION OVERRULED IN LOS ANGELES.—The suit begun a year ago by the Pacific States Telephone & Telegraph Company against the city of Los Angeles to prevent the enforcement of the rate reduction ordered by the City Council on May 31, 1910, has been dismissed by agreement. Acting on the advice of experts, the city attorney decided that it was impossible to defend the reduced rates as affording a proper return on investment. Accordingly the city attorney and the company's attorneys agreed to a dismissal, as in the meantime the Board of Public Utilities of Los Angeles had recommended the old rates, which the City Council accepted finally. The stipulation settling the suit provides that the city shall pay $950 costs and also orders the payment to the company of the impounded money held up during litigation, being $44,000, representing the difference between the old rates and those which the City Council attempted to enforce.

* * *

MONSTER RAILROAD TERMINAL PROPOSED IN CHICAGO.—A project is under discussion by which thirteen of the trunk railroads entering Chicago, or nearly half of the total number, may unite in building a great freight and passenger terminal station on both sides of Twelfth Street between State Street and Clark Street. The frontage of the proposed passenger station forming a portion of this terminal would be 750 ft. long on the south side of Twelfth Street. The use of the new terminal would mean the abandonment of the present Polk Street and La Salle Street terminals. The plan also contemplates the movement of freight trains on the level of the ground by means of electric locomotives. Passenger traffic will be handled on an upper level. The railroads which may possibly unite in this proposal are the Chicago & Western Indiana, Santa Fé, Erie, Wabash, Grand Trunk, Monon, Chesapeake & Ohio, Rock Island, Lake Shore, Chicago & Eastern Illinois, Nickel Plate, Chicago & Southern and the "Soo" Line.

Chicago A. I. E. E. Section.—At a meeting held on Oct. 18 Messrs. J. G. Wray and Ralph H. Rice were elected members of the executive committee of the Chicago Section of the American Institute of Electrical Engineers. The other members of the committee are Mr. W. L. Abbott, Mr. W. B. Jackson, Prof. John D. Nies and Mr. Fay Woodmansee.

* * *

Seattle N. E. L. A. Convention.—The armory in Seattle has been engaged for the annual convention next year of the National Electric Light Association. An exhibition will be made in connection with the convention. The executive committee has decided to limit the sessions to three days; also to limit, as far as practicable, the entertainment features.

* * *

Resuscitation from Electric Shock.—The Austrian-Hungarian Society of Electrical Engineers has adopted a code of rules for resuscitation from electric shock, employing the Sylvester method of artificial respiration, according to which the patient is operated upon face upward. Dr. Jellinck, of Vienna, the eminent authority on electrical physiology, was consulted in the preparation of the rules.

* * *

Girls' Club of Commonwealth Edison Company.—A girls' club has been organized among the girls employed by the Commonwealth Edison Company, Chicago. Of the ninety-five employees of the company of the gentler sex, seventy-seven signed the roll at the first meeting of the new club. Semi-monthly meetings are held, and musical and literary programs are given. Miss Creed is president of the club and Miss Spears is secretary.

* * *

Philadelphia Section, I. E. S.—A meeting of the Philadelphia Section of the Illuminating Engineering Society was held at 1000 Chestnut Street on Oct. 20, 1911, at which time Mr. Sidney W. Ashe, presented a paper entitled "The Training of Commercial Men in the Fundamentals of Illumination." The paper was illustrated with experiments and lantern slides. The author described the methods of instruction employed with college graduates at the Harrison lamp works of the General Electric Company.

* * *

New York Electrical Society.—During the present week, on Oct. 27, Major George O. Squier, of the United States Signal Corps, lectured before the New York Electrical Society on electric waves directed by wires for intercommunication purposes. The lecture dealt with the simultaneous transmission of wireless and wire intercommunications by means of the same equipment, United States patents for which were dedicated by Major Squier to the citizens of the United States. The lecture was illustrated by lantern slides.

* * *

Railway Electrical Engineers' Convention.—Those in charge of the preparations for the annual convention of the Association of Railway Electrical Engineers, which will be held in the Hotel La Salle, Chicago, on Nov. 6 to 10, are confident that the convention will be the largest and best ever held by the association. The Railway Electric Supply Manufacturers' Association, an auxiliary body, is especially active in arranging for the entertainment of the visitors and for an exhibit of machinery and appliances which it is hoped to make particularly full and valuable.

* * *

Telharmonic Music in New York.—In our issue for Jan. 5, 1911, appeared a brief note relating to the application by the New York Cahill Telharmonic Company for a franchise to distribute music electrically throughout New York City. Our issue for April 28, 1910, contained an illustrated article in which were described the details of the improved Cahill telharmonic equipment. This latter equipment has been moved from Holyoke, Mass., to New York City, and has been tested with highly satisfactory results in its new location at 535 West Fifty-sixth Street. It will be placed in actual commercial service in the near future.

* * *

Louisville & Nashville Railroad Enters Telegraph Field.—At a meeting of the board of directors of the Louisville & Nashville Railroad in New York City a short time ago it was decided that they would not continue the contract with the Western Union Telegraph Company, but would construct telephone and telegraph lines of their own. The Louisville & Nashville Railroad has used the lines of the Western Union since 1884, and the last contract expired Aug. 17, 1911. The new lines will not only be used for railroad purposes, but also for commercial messages. The railroad operates 4500 miles of line through the Western and Southern States, covering the territory from Louisville to Florida and St. Louis.

* * *

Vice-president Sherman on Conservation at Hydro-electric-Plant Opening.—Vice-president James S. Sherman delivered the principal speech at the opening of the new municipal water-power plant at Sturgis, Mich., Oct. 12, which was celebrated by an assembly of 10,000 people. The Sturgis plant, which contains several features of novelty, was designed by Prof. Gardner S. Williams, of Ann Arbor, Mich., and has been described in the *Electrical World* of Aug. 25, 1910. Vice-president Sherman advocated the best use of the hidden forces of nature for the advancement of mankind, urging that they be made to supply comforts and conveniences and to lighten the burdens of the present generation. Coming generations, he said, will be entirely capable of discovering their own solutions of fuel and energy sources to take the place of exhausted natural resources.

* * *

Baltimore A. I. E. E. Section.—The Baltimore Section of the American Institute of Electrical Engineers has decided to hold two classes of meetings during the coming year. The first class will be more or less of a formal nature, and prominent engineers will be invited to read papers of interest as during the meetings of the past year. Interested non-members will also be invited to attend these meetings, of which there will be not more than four during the course of the year. The second class of meetings will be less formal and will be limited to the members of the section. It is proposed that at these meetings the regular routine business of the section will be conducted, papers of interest published by the Institute will be discussed informally by the members, and light refreshments, including "smokers," will be furnished. The first public meeting was held on Oct. 20 in the Physical Laboratory of the Johns Hopkins University, the subject for discussion being "The Cost of Industrial Power."

* * *

Harrison Street Station, Chicago, Now a Substation.—After a career of about twenty years as a generating station the Harrison Street station of the Commonwealth Edison Company, in Chicago, has been relegated to the rank of a substation. This station was put in service about the year 1892 and its erection was one of the first achievements of Mr. Samuel Insull when he became president of the old Chicago Edison Company. When built the station was considered one of the finest in the country, but at the present time its entire output rating is not as large as that of a single unit in the new Northwest station, which will soon be put into commission. With the great Fisk Street, Quarry Street and Northwest generating stations in service the Harrison Street plant will not be needed for the generation of electricity, and so the once famous plant drops into the "has-been" class—a significant commentary on the rapid development of electrical engineering and the expansion of electric service from central stations.

THE FIRST 110,000-VOLT INSTALLATION IN EUROPE.

Details of Lauchhammer Transmission System for the Supply of Electric Power to Rolling Mills.

Steam Generating Plant Located at Coal Mines.—Duplicate Conductors Installed on Single-Tower Line.—Slender Tower Construction.

By Kurt Perlewitz.

THE first 110,000-volt transmission system in Germany is now being installed and will be ready for operation in November. It is being built for the Lauchhammer Aktiengesellschaft, which owns large iron works at Lauchhammer, Gröditz, Riesa and Burghammer and also large coal mines at Lauchhammer. On account of enlargements of these works in recent years and the building of electrically operated rolling mills the present power supply was found insufficient and it was decided to build a large generating station from which all the works were to be furnished with electrical energy through high-tension transmission. Fuel for the generating station is to be furnished from the coal mines at Lauchhammer.

Besides the demand of approximately 6600 kw from its own works the plant is to furnish energy for a large portion of the province, containing four towns, 658 villages and 164 large estates, the demand of which is at the present time approximately 6000 kw. According to the estimates there will be connected immediately more than 116,000 incandescent lamps and over 21,500 hp in motors. The ultimate demand being calculated to aggregate about 20,000 kw, it was decided to transmit the energy at a tension of 110,000 volts. The distance of hardly 35 miles did not require such a high voltage, but the large load to be carried and the fluctuation of voltage to be expected through the rolling-mill load would have made a lower voltage uneconomical. The selection of the voltage was also influenced by the question of insulators, transformers and switch gear, which had to be of special design for any tension over 65,000 volts. Therefore, it would make little difference in regard to cost of apparatus and appliances whether an 85,000-volt or a 110,000-volt system was decided upon, while with the latter voltage it would make a considerable saving in cost of copper. A pressure of 65,000 volts requires a conductor of 0.186 sq. in. cross-section, while 85,000 volts and 110,000 volts only require a copper cross-section of 0.11 sq. in. and 0.065 sq. in., respectively.

GENERATING STATION.

The plant at Lauchhammer, shown in Fig. 1, consists of boiler-room, engine-room and switchroom. The dimensions in this and other illustrations are all given in millimeters. The boiler equipment will consist of eighteen double-flue boilers, of which only twelve are installed at present. Each boiler will have 1600 sq. ft. of heating surface and be provided with superheaters. Use will be made of automatic stokers, for which the Lauchhammer coal is particularly well adapted.

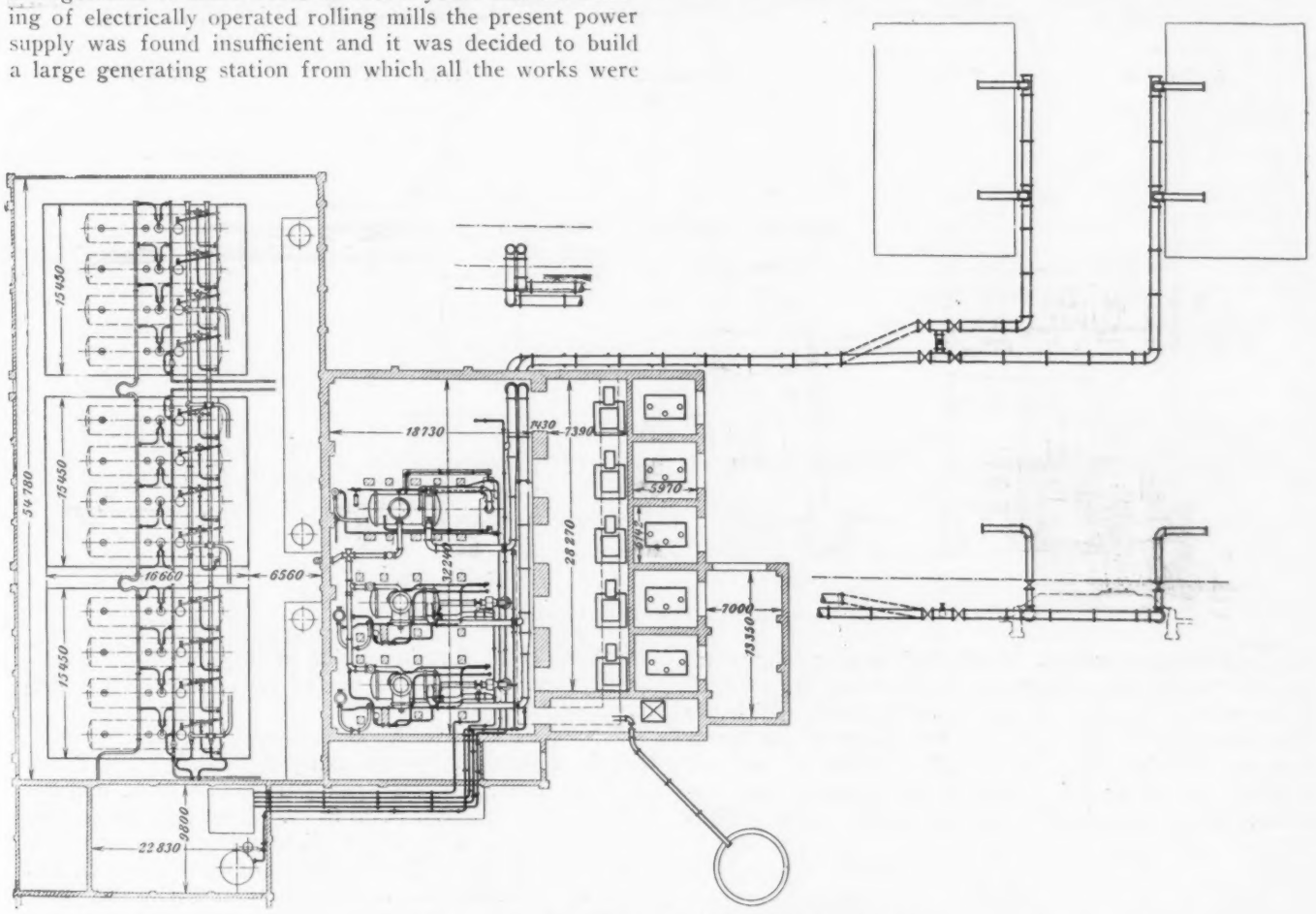
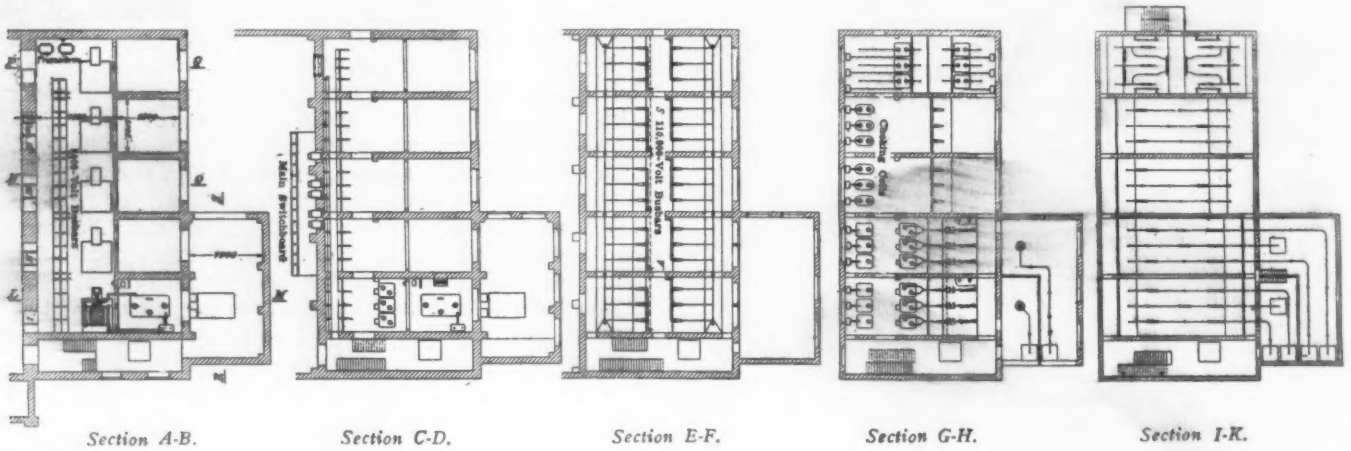


Fig. 1—Plan of Generating Station at Lauchhammer.

The feed water is heated in economizers. Instead of smokestacks the Schwalbach suction-draft system is used. Each group of four boilers forms one unit and each unit is provided with one 50-hp motor for the fans. The generating equipment will consist of four turbo-generators, of which three are being installed. Each generator is a three-phase machine designed for 5000-kw output at a power-factor of 0.8 and an emf of from 4740 volts to 5500 volts. Two of these sets were made by the Allgemeine Electricitäts-Gesellschaft and one set by the Maschinenfabrik Augsburg-Nürnberg, together with the Siemens-Schuckertwerke.

From the generators the energy is transmitted through cables to the 5000-volt main busbars in the switch house. The busbars are in duplicate and are provided with dis-

connecting switches so that one set can be cut out without causing disturbance. There are joined to these buses two T-connected transformers with a secondary emf of 1450 volts, at which voltage about 1000 kw will be delivered at



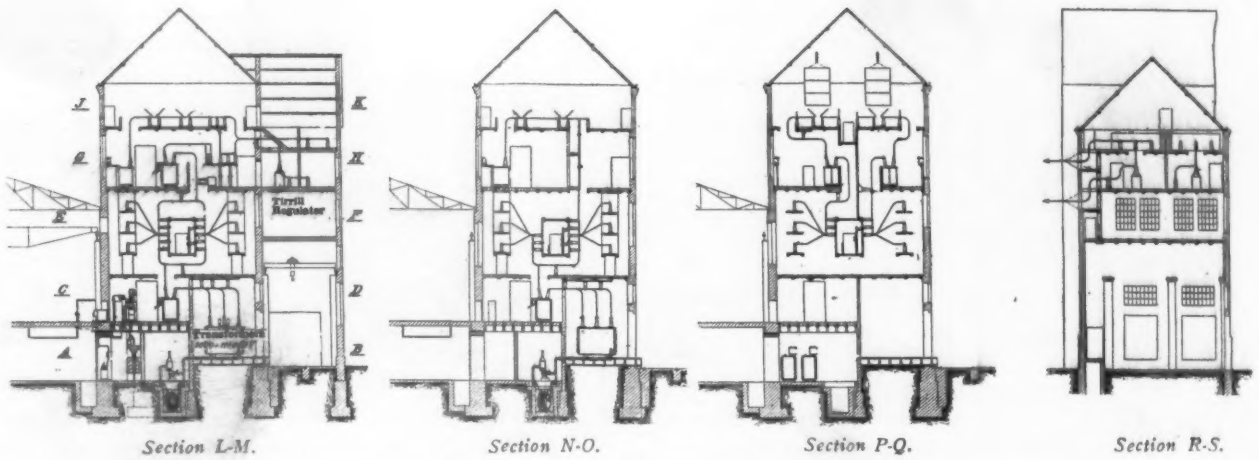


Fig. 2—Elevations and Sections of Switch House at Lauchhammer.

the Lauchhammer works. Connected to these buses are also four 6250-kva, three-phase transformers from which the energy is delivered to 110,000-volt busbars, which are also furnished in duplicate. On both sides of the transformers are installed disconnecting switches and oil switches, the latter being electrically operated and controlled from a central switch panel. In the outgoing high-

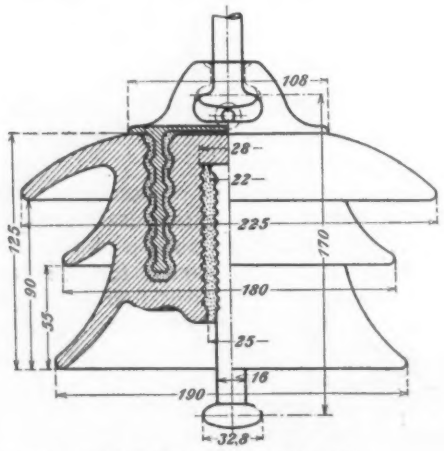


Fig. 3—Suspension-Insulator Unit.

tension lines are installed disconnecting switches, oil switches, choke coils and lightning arresters, as illustrated in Fig. 2. The switch gear and transformers were made by the Siemens-Schuckertwerke.

TRANSMISSION LINE.

The conductors, which are installed in duplicate, are carried on one line of iron towers set in concrete foundations. The one-line system of towers was adopted on account of the difficulty of securing rights of way for two separate tower lines. The towers are of steel lattice-girder construction.

Each conductor is of seven-strand, hard-drawn, electrolytic copper of approximately 83,000-circ. mil cross-section. The spans are from 500 ft. to 650 ft. and the height varies from 60 ft. to 65 ft. A noteworthy feature is the span across the River Elbe, which has a length of nearly 900 ft., the height of the towers being 140 ft. and 120 ft. For this span various kinds of conductors were considered, such as stranded steel cables, copper wire with steel core, bronze wire and others, but careful calculations showed that pure electrolytic, seven-strand, 140,000-circ. mil copper cable would prove best for carrying the maximum load of ice and snow, the calculation being based on a factor of safety of five. Five-unit suspension insulators, made by the Porsellanfabrik Kahla, in Helmsdorf, are used

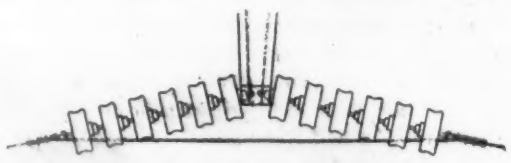


Fig. 4—Strain Insulator on Curve of Transmission Line.

on all intermediate towers. At crossings of streets, railways, rivers and certain other places use is made of two 6-unit strain insulators made by Rosenthal, in Selb, Bavaria. All conductors are carried on one pole line and each set

of three conductors forms an equilateral triangle, the sides of which are 5.9 ft. For this purpose the upper cross-arm is bent, as shown in the accompanying illustration. Under each conductor is a ground connection in the shape of a bow supported on cross-arms, as shown in Fig. 7. This bow serves the purpose of catching and grounding the conductor in case the insulator should break. At the top of the tower is a 100,000-circ. mil steel ground wire, serving the double purpose of anchoring the intermediate towers and protecting the line against lightning. There

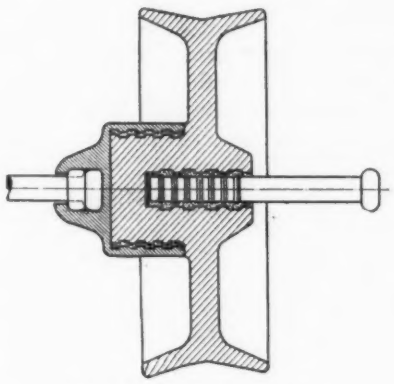


Fig. 5—Strain Insulator.

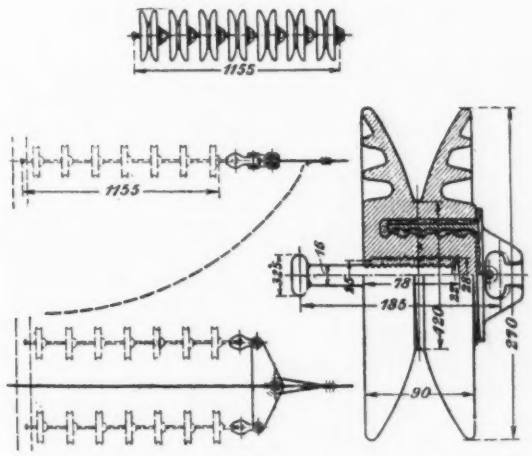


Fig. 6—Strain Insulator Used at Crossing of River Elbe.

strain insulators have been used, as shown in Fig. 6. In regard to the protection of the stations against high-frequency disturbances advantage was taken of the experiences gained at similar installations in America. Ground resistances are installed in all outgoing lines and between busbars, choke coils and horn-gap lightning arresters. Static dischargers are connected at the neutral point of the high-tension winding of the instrument transformers. The voltage regulation of the system is effected by Tirrill regulators in the main station and also by regulating trans-

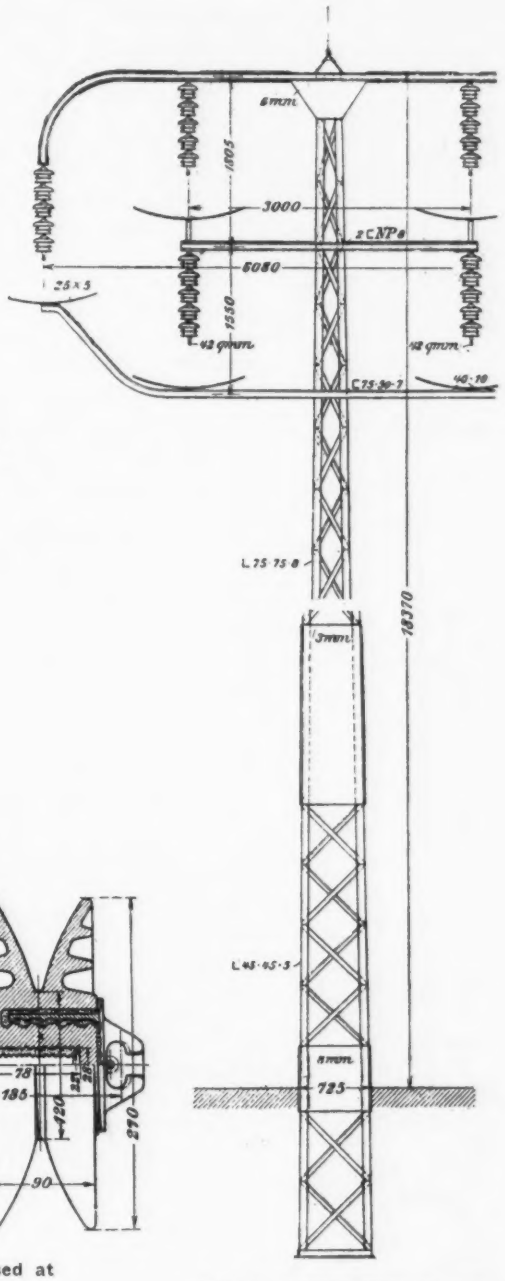


Fig. 7—Intermediate Tower.

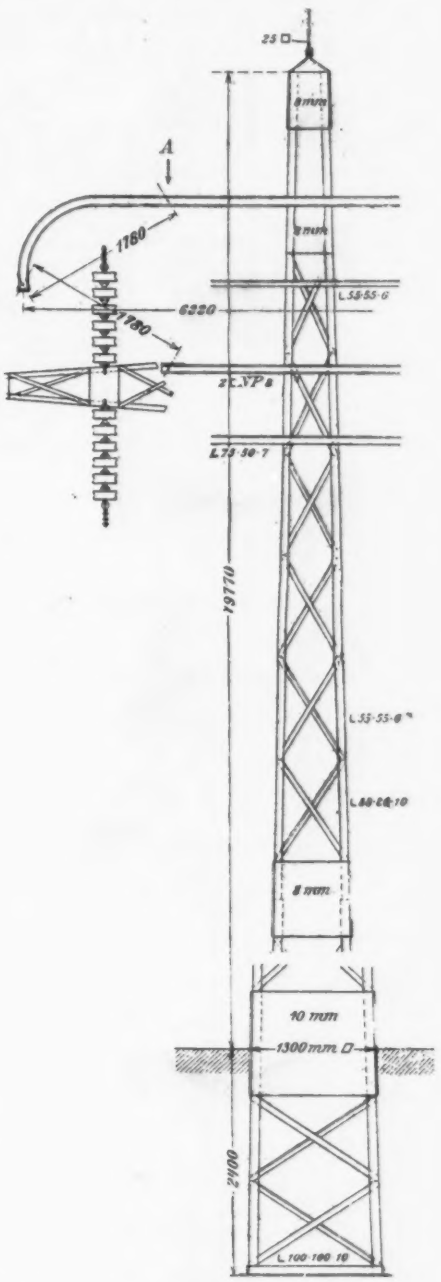


Fig. 8—Straight Tower.

are thus two systems of grounded connections at each tower. In order to prevent inductive disturbances the wires are completely transposed once in every mile, or altogether over thirty times. This arrangement not only eliminates the inductive effects on neighboring telephone lines, but also prevents mutual induction and electrolytic influence of the two parallel circuits. It will be noticed that, by the bow-shaped form at the upper cross-arm the conductors are hung symmetrically, and inequality in the self-induction of the phases is thus prevented. This arrangement was devised by Professor Ulbricht.

At the crossing of the River Elbe two double sets of formers on the 15,000-volt side in the main transformer station, which allow a variation of 750 volts.

SUBSTATIONS.

The substation at Gröditz, the arrangement of which is shown in Figs. 9 and 10, comprises an installation of three 3000-kva transformers and two 7000-kva transformers, the former stepping down the emf from 110,000 volts to 15,000 volts and the latter stepping down from 110,000 volts to 60,000 volts. Besides being connected through the 110,000-volt line the substations at Gröditz and Riesa are also connected through a 60,000-volt line covering the districts served by these stations.

The stations are so arranged that any of the two can furnish energy for the whole district in case of a breakdown of the other. This arrangement also eliminates reserve transformers. The consumers are served from five

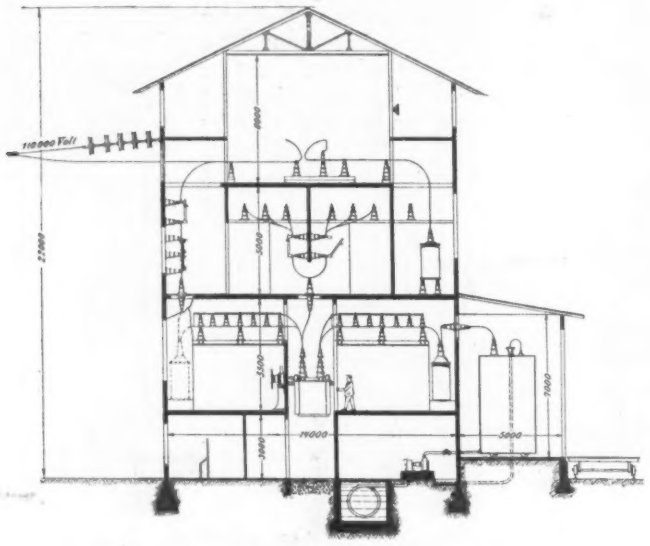


Fig. 9—Section of Substation at Gröditz.

transformer stations on this line, each distributing energy at 15,000 volts.

The design of the installation was made by Mr. E. G.

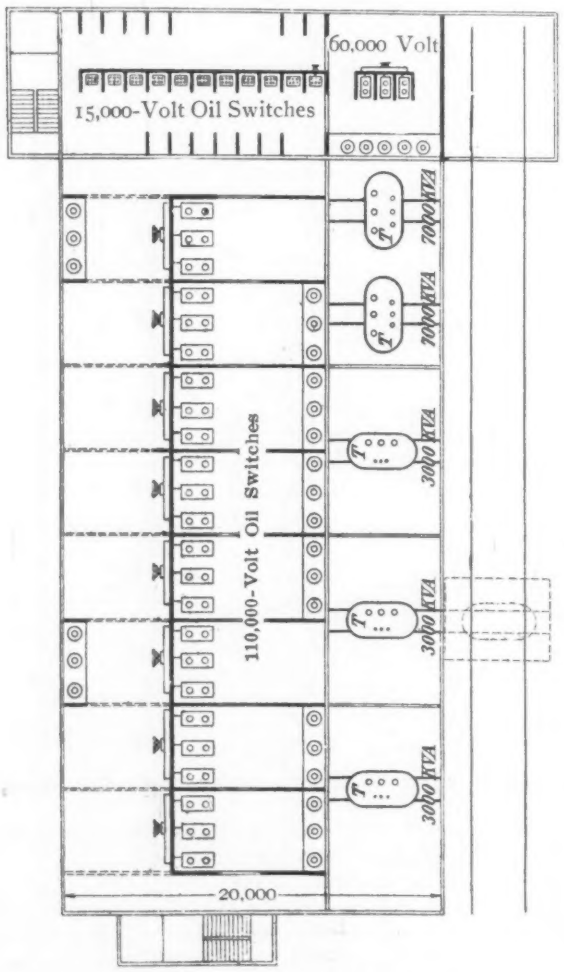


Fig. 10—Plan of Substation at Gröditz.

Fishinger, Dresden, who also supervised the construction work. The illustrations accompanying the present article have been reproduced from an article by Mr. Fishinger which appeared in the *Elektrotechnische Zeitschrift*.

THE HEATING OF SYNCHRONOUS CONVERTERS.

The Effect of Power-Factor on the Average and on the Maximum Heating.

By Nicholas Stahl.

FOR commercial reasons modern synchronous converters are built with coils of uniform section. The armature copper loss is, however, very unequally distributed, the coils nearest the taps to the collector rings having to withstand far more than the average. Consequently, as an added margin of safety, many manufacturers build their machines to carry without injury the maximum currents established in the tap coils, assuming, with the justification of experience, that even the best ventilated machines are not able to equalize to any considerable extent the heat generated by conduction along the copper or through the insulating walls.

It is also well known that the variations in local heating increase markedly with the decrease of the power-factor below 100 per cent, which fact becomes of importance in connection with the subject of compounding by series field current and reactance in the alternating-current circuit, since, with reasonable values of these quantities, as well as of ohmic drop, an attempt even to hold up the volt-

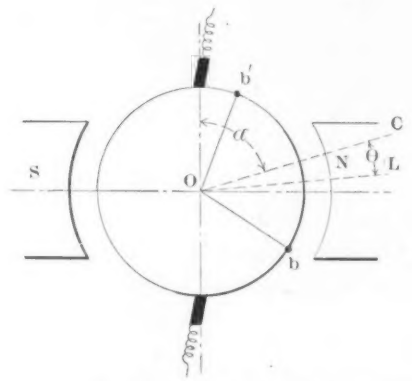


Fig. 1—Diagram Showing Meaning of Angles.

age to normal will involve a decided departure of the power-factor (leading) from 100 per cent, with a consequent excess heating in all the coils, and in the tap coils particularly.

The question of unequal heating is of importance also in connection with the type of machine which is self-starting from the alternating-current end, in view of the starting requirement of from one to one and one-half times normal kilovolt-ampere input at a very low power-factor.

The curves given below afford a ready answer not only to the question of ratings of a machine used with different numbers of slip-rings (phases)—say, three or six—but to the query as to why it is not advisable to start a six-phase machine, arranged with the low-tension sides of the transformers in double-delta, as a three-phase machine, in order to save switches and more operations for the attendant.

The theory on which the curves are based is as follows: Let p be the number of phases (or, rather, the number of rings).

E_p the effective alternating emf between rings.

I_p the effective alternating current in any armature path.

E_o the commutator voltage.

I_o the direct current in any armature path.

Cos θ the power-factor.

η the efficiency at full load.

Then for the equality of input and output with ordinary parallel windings with two armature paths from a brush set,

$$\eta p E_p I_p \cos\theta = 2 E_o I_o \qquad (1)$$

The ratio between E_p and E_o is easily shown to be

$$E_p = \frac{E_o}{\sqrt{2}} \sin \frac{\pi}{p} \qquad (2)$$

or, substituting in (1),

$$I_p = \frac{I_o 2\sqrt{2}}{\eta p \sin \frac{\pi}{p} \cdot \cos\theta} \qquad (3)$$

or the maximum value of the alternating current in any path will be:

$$I_p \max = \frac{I_o 4}{\eta p \sin \frac{\pi}{p} \cdot \cos\theta} \qquad (4)$$

If in Fig. 1 a represents the angle between the mid coil of a phase winding (that is, coils lying between two adjacent collector rings) and the diameter of commutation (assumed on the neutral point), and θ is the angle of lag of current behind impressed emf, then it will be clear that the coil bb' will have the maximum alternating current through it when the line OL passes through the middle of a pole—that is when $a + \theta = 90$ deg. Assuming, as heretofore, that the field form is sinusoidal, we have for the instantaneous value of the alternating current

$$i' = \frac{I_o 4 \sin(a+\theta)}{\eta p \sin \frac{\pi}{p} \cdot \cos\theta} \qquad (5)$$

That is, the current (alternating) in any bar between b and b', and the total current, considering the reversal of the direct current on passing a brush, and that the direct current and alternating current first oppose each other, will be:

$$\text{Total instantaneous current} = I_o - \frac{I_o 4 \sin(a+\theta)}{\eta p \sin \frac{\pi}{p} \cdot \cos\theta} \qquad (6)$$

The average heating for a given bar β deg. from the center of bb' is (6) integrated over half a cycle, from β to $\pi + \beta$, or

$$\frac{I_o}{\pi} \int_{\beta}^{\pi+\beta} \left(1 - \frac{4 \sin[a+\theta]}{\eta p \sin \frac{\pi}{p} \cdot \cos\theta}\right)^2 da$$

$$= \frac{I_o}{\pi} \int_{\beta}^{\pi+\beta} \left[1 - \frac{4(\sin a + \cos a \tan\theta)}{\eta p \sin \frac{\pi}{p}}\right]^2 da$$

$$= \frac{I_o}{\pi} \int_{\beta}^{\pi+\beta} \left[1 + \frac{16 \sin^2 a}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} + \frac{16 \cos^2 a \tan^2\theta}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} - \frac{8 \sin a}{\eta p \sin \frac{\pi}{p}} - \frac{8 \cos a \tan\theta}{\eta p \sin \frac{\pi}{p}} + \frac{16 \sin a \cos a \tan\theta}{\eta p \sin \frac{\pi}{p}}\right] da$$

$$= I_o \left[1 + \frac{8}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} + \frac{8 \tan^2\theta}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} - \frac{16 \cos\beta}{\pi \eta p \sin \frac{\pi}{p}} + \frac{16 \sin\beta \cdot \tan\theta}{\pi \eta p \sin \frac{\pi}{p}}\right] \qquad (7)$$

The expression in brackets gives the ratio of the heating of a converter coil to that of the same coil in a direct-current generator, disregarding the question of the efficiency of the latter; to include this it is only necessary to multiply its value into the bracket, so that for a converter of, say, 95 per cent efficiency at full load and a generator of perhaps 92 per cent, the consideration of efficiencies leads to some 3 per cent variation in the ratio of respective heatings.

The last term in the brackets, $\frac{16 \sin\beta \cdot \tan\theta}{\pi \eta p \sin \frac{\pi}{p}}$, brings out the point often forgotten that at power-factors differing from unity the heating even in the tap coils will not be the same at opposite ends of a phase winding, being greater by twice the value of this term for the front tap-coil with respect to physical rotation, when $\sin\beta$ is positive, and the wattless current lagging; or, with respect to a tap leading to the collector ring it is the after-coil; with a leading wattless current the conditions reverse. A lagging wattless current shifts forward with respect to rotation the coil having the least heating and vice versa.

The average heating for the entire winding is found by integrating (7) through the entire extent of the phase and gives

$$\frac{p}{2\pi} \cdot I_o \int_{-\frac{\pi}{p}}^{\frac{\pi}{p}} \left[1 + \frac{8}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} + \frac{8 \tan^2\theta}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} - \frac{16 \cos\beta}{\pi \eta p \sin \frac{\pi}{p}} + \frac{16 \sin\beta \tan\theta}{\pi \eta p \sin \frac{\pi}{p}}\right] d\beta$$

$$= I_o \left[1 + \frac{8}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} + \frac{8 \tan^2\theta}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} - \frac{2 \cdot 16 \cdot 2 \sin \frac{\pi}{p}}{2\pi \cdot \pi \eta p \sin \frac{\pi}{p}}\right]$$

$$= I_o \left[1 + \frac{8}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} + \frac{8 \tan^2\theta}{\eta^2 p^2 \sin^2 \frac{\pi}{p}} - \frac{16}{\pi^2 \eta}\right] \qquad (8)$$

For three-phase, two-phase (four-ring) and six-phase converters equation (7) reduces as follows:

$$\text{Relative coil heating (three-phase)} = 1 + \frac{32}{27\eta^2} + \frac{32 \tan^2\theta}{27\eta^2} - \frac{32 \cos\beta}{\pi\eta 3\sqrt{3}} + \frac{32 \sin\beta \tan\theta}{\pi\eta 3\sqrt{3}} \qquad (9)$$

$$\text{Relative coil heating (two-phase)} = 1 + \frac{1}{\eta^2} + \frac{\tan^2\theta}{\eta^2} - \frac{8 \cos\beta}{\pi\eta\sqrt{2}} + \frac{8 \sin\beta \tan\theta}{\pi\eta\sqrt{2}} \qquad (10)$$

$$\text{Relative coil heating (six-phase)} = 1 + \frac{8}{9\eta^2} + \frac{8 \tan^2\theta}{9\eta^2} - \frac{16 \cos\beta}{\pi\eta 3} + \frac{16 \sin\beta \tan\theta}{\pi\eta 3} \qquad (11)$$

The corresponding average heating ratios are:

$$\text{three-phase} = 1 + \frac{32}{27\eta^2} - \frac{16}{\pi^2\eta} + \frac{32 \tan^2\theta}{27\eta^2} \qquad (12)$$

$$\text{two-phase} = 1 + \frac{1}{\eta^2} - \frac{16}{\pi^2\eta} + \frac{\tan^2\theta}{\eta^2} \qquad (13)$$

$$\text{six-phase} = 1 + \frac{8}{9\eta^2} - \frac{16}{\pi^2\eta} + \frac{8 \tan^2\theta}{9\eta^2} \qquad (14)$$

Assuming an efficiency of 100 per cent, the last three equations simplify to:

$$\text{three-phase} = 0.565 + 1.185 \tan^2\theta \qquad (12')$$

$$\text{two-phase} = 0.38 + \tan^2\theta \qquad (13')$$

$$\text{six-phase} = 0.268 + 0.888 \tan^2\theta \qquad (14')$$

Since the ratings for equal heatings are proportional to the currents, the reciprocals of the square roots of (12′), (13′), (14′) allow a ready determination, as indicated in Fig. 2.

It will be observed that one-half the rating shown for a given power-factor will represent within 2 or 3 per cent the per cent load that may be carried with the same *total* heating allowed at normal full load and unity power-factor. How far this must be modified when the allowable heating in a tap coil is considered is indicated by the accompanying curves, which show the heatings for the

front and back tap coils, the middle and the average coils, Figs. 3, 4 and 5 representing respectively the performances of three-ring, four-ring and six-ring converters, 100 per cent efficiency being assumed. In equations (7) to (14) the efficiency factor has been included, but it may be noted that approximate purposes will be served if the heatings for 100 per cent efficiency are divided by the square of the efficiency factor for any particular machine.

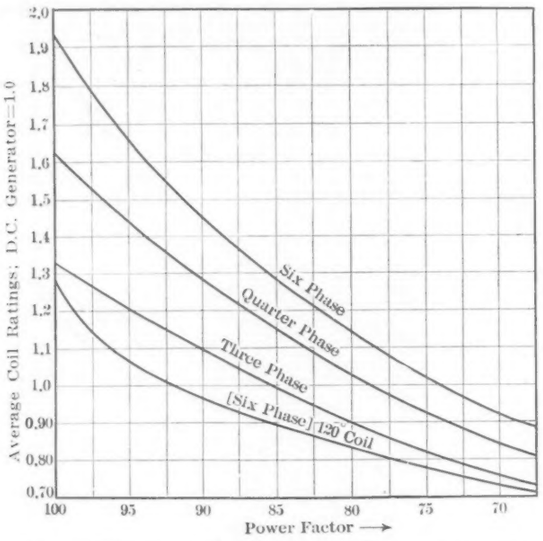


Fig. 2—Ratings of Three-Ring, Four-Ring and Six-Ring Converters for Equal Average Heating.

Inquiry is frequently made regarding the performance of both three-phase and six-phase synchronous converters when one of the transformers fails or is cut out of service for any reason. In the case of the three-phase or of the six-phase machines when the transformers of the latter are connected in double delta it is sufficient to remark that the load which may be carried is limited by the outputs of the two transformers left in open delta, or "V." Should these be operated to give normal full-load current on the low-tension side, the transformer will be carrying an overload of 15.5 per cent, and the synchronous converter will, of course, be operating at only two-thirds of its rated output, with corresponding heating. There are no unbalanced currents in the converter armature.

However, the case is different with a six-phase converter for which the transformers are diametrically connected, since after cutting out one the machine may be regarded as operating on a two-phase (four-ring) circuit, but with the phases distorted so as to have 120 deg. between one pair of phase wires and 60 deg. between the next succeeding two. Under these conditions the currents in the converter armature will be very considerably unbal-

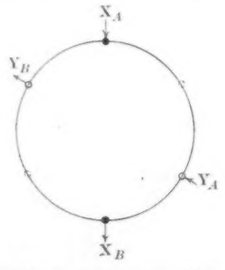


Fig. 3—Six-Phase Converter; Two Idle Taps.

anced, with a consequent increase of heating, which will, however, be that neither of a three-phase nor of a four-phase machine, and the permissible output of the converter will depend upon whether it is to be based on the maximum heating of any particular coil or on the average heating of the coils.

In Fig. 2 are shown the ratings as calculated from the average heating of the converter based on the 120-deg. coil. The results given below will enable rapid calcula-

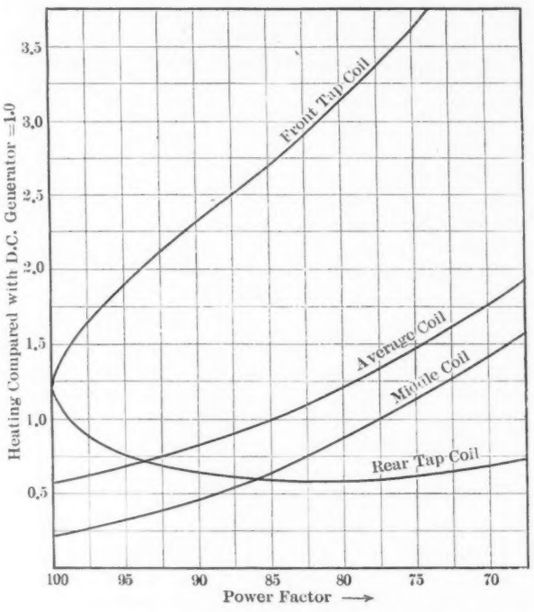


Fig. 4—Distribution of Heating in Coils of Three-Phase Converter.

tion in the case of the front and rear tap-coils and the middle coils of the winding.

If I represents half the effective full-load current in a given transformer, the heating in the long coil (l) is determined by the maximum current which can flow during half a cycle, which is ascertained as follows: The instantaneous current in the winding will be the vector sum of the currents flowing from the two active transformers having currents, for unity power-factor, of

$$i_x' = I_x \text{ (max) } \sin \alpha$$

and

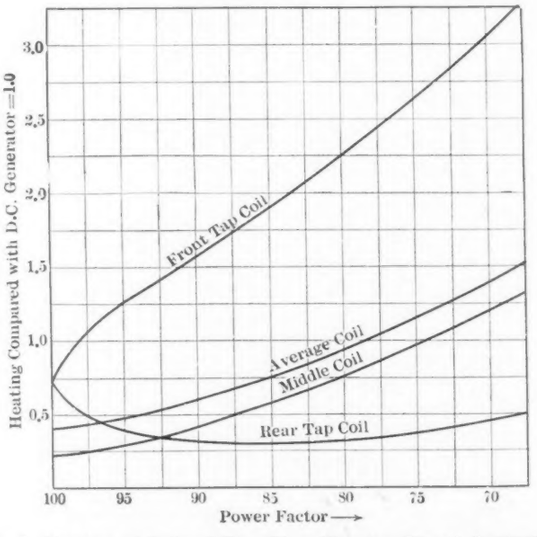


Fig. 5—Heating of Coils of Two-Ring (Quarter-Phase) Converter.

$$i_y' = I_y \text{ (max) } \sin (\alpha - 120 \text{ deg.})$$
$$= I_x \text{ (max) } \sin (\alpha - 120 \text{ deg.})$$

In Fig. 3 X_A and Y_A are the points of attachment of the transformer windings of like polarity and sequence; when

$+I_x$ (max) enters at X_A, current at Y_A will be negative (incidentally equal to $-\frac{I_y\,(\max)}{2}$; hence the current leaves (physically) Y_A, so the vector sum producing the instantaneous current in the coil is (I indicates maximum current):

$$i_1' = I\sin\alpha - I\sin(\alpha - 120\text{ deg.})$$
$$= I\,(\sin\alpha - \sin\alpha\cos 120\text{ deg.} + \cos\alpha\sin 120\text{ deg.})$$
$$= I\left(\frac{3}{2}\sin\alpha + \frac{\sqrt{3}}{2}\cos\alpha\right) \qquad (15)$$

Now I is also half the maximum value of the current in an armature path for ordinary six-phase operation, since the line current, which is equal to the full effective current of a transformer, $2I$, is the vector difference of the currents in two adjacent sections of an armature 60 electrical space and time degrees apart; hence, $I_{line} = 2I_{arm} \times \sin 30 = I_{arm} = 2I$. Now for six-phase I_a (max) $= \frac{4}{3} I_o$, hence $I = \frac{I_{a\,(max)}}{2} = \frac{2}{3} I_o + i'_1 = \frac{I_o}{\sqrt{3}}(\sqrt{3}\sin\alpha + \cos\alpha)$

With unity power-factor the maximum value of i_1 will occur when the center of the phase winding is opposite the center of the pole, so α is measured from the commutation diameter if on the neutral.

With a power-factor $\cos\theta$ (lagging) the maximum value of the current will be represented by an instantaneous value of

$$i_1 = \frac{I_o}{\sqrt{3}}\cdot\frac{\sqrt{3}\sin[\alpha+\theta] + \cos[\alpha+\theta]}{\cos\theta}$$
$$= \frac{I_o}{\sqrt{3}}(\sqrt{3}\sin\alpha + \sqrt{3}\cos\alpha\tan\theta + \cos\alpha - \sin\alpha\tan\theta)$$
$$= \frac{I_o}{\sqrt{3}}(\sin\alpha[\sqrt{3} - \tan\theta] + \cos\alpha[1 + \sqrt{3}\tan\theta])$$

The total instantaneous current, considering the reverse direction of the direct current, is

$$i_t = I_o\left\{1 - \frac{\sin\alpha}{\sqrt{3}}[\sqrt{3} - \tan\theta] + \frac{\cos\alpha}{\sqrt{3}}[1 + \sqrt{3}\tan\theta]\right\} \qquad (16)$$

The instantaneous heating will be the square of this, and the average heating for a half (or whole) cycle for a given conductor distant β deg. from the center of the coil is

$$= \frac{I_o}{\pi}\int_{\beta}^{\frac{\pi}{3}+\beta}\left\{1 - \frac{\sin\alpha}{\sqrt{3}}[\sqrt{3} - \tan\theta] - \frac{\cos\alpha}{\sqrt{3}}[1 + \sqrt{3}\tan\theta]\right\}^2 d\beta \qquad (17)$$
$$= \frac{I_o}{\pi}\int_{\beta}^{\frac{\pi}{3}+\beta}\left\{1 + \frac{\sin^2\alpha}{3}[\sqrt{3} - \tan\theta]^2 + \frac{\cos^2\alpha}{3}[1 + \sqrt{3}\tan\theta]^2 - \frac{2\sin\theta}{\sqrt{3}}[\sqrt{3} - \tan\theta] - \frac{2\cos\alpha}{\sqrt{3}}[1 + \sqrt{3}\tan\theta] + \frac{2}{3}\sin\alpha\cos\alpha[\sqrt{3} - \tan\theta][1 + \sqrt{3}\tan\theta]\right\} d\beta$$
$$= I_o\left\{\frac{5}{3} + \frac{2}{3}\tan^2\theta - \frac{4}{\sqrt{3}\pi}\cos\beta[\sqrt{3} - \tan\theta] + \frac{4}{\sqrt{3}\pi}\sin\beta[1 + \sqrt{3}\tan\theta]\right\} \qquad (18)$$

The ratio of the heating of a bar to what it would be when operating as a direct-current generator is the term in brackets.

When the power-factor is unity, $\cos\theta = 1$ and $\tan\theta = 0$, and equation (18) becomes

$$I_o\left\{\frac{5}{3} - \frac{4\cos\beta}{\pi} + \frac{4\sin\beta}{\sqrt{3}\pi}\right\}$$

The ratio of the permissible output ratings to that of the machine as a direct-current generator equals $\frac{1}{\sqrt{\frac{5}{3}}} = 77.5$ per cent for a front tap-coil for which $\beta = 60$ deg.

The corresponding heating of the front tap-coil for a six-phase machine is 0.418, and the ratio of the permissible output ratings on this basis is $\sqrt{\frac{0.418}{1.666}} = 50$ per cent.

Similarly, the short (60-deg.) coil has instantaneous alternating current.

$$i_s' = I\sin\alpha + I\sin(\alpha - 120\text{ deg.}) = \frac{I_o}{3}(\sin\alpha - \sqrt{3}\cos\alpha) \qquad (19)$$

and at power-factor $= \cos\theta$

$$i_s' = \frac{I_o}{3}(\sin\alpha[1 + \sqrt{3}\tan\theta] - \cos\alpha[\sqrt{3} - \tan\theta])$$

and the total instantaneous current is

$$i_s = I_o\left\{1 - \frac{\sin\alpha}{3}[1 + \sqrt{3}\tan\theta] + \frac{\cos\alpha}{3}[\sqrt{3} - \tan\theta]\right\}$$

which, by the same reasoning as the foregoing, leads to a total heating of

$$I_o\left\{\frac{11}{9} + \frac{2\tan^2\theta}{9} - \frac{4\cos\beta}{3\pi}[1 + \sqrt{3}\tan\theta] - \frac{4\sin\beta}{3\pi}[\sqrt{3} - \tan\theta]\right\} \qquad (20)$$

At unity power-factor this becomes

$$I_o\left\{\frac{11}{9} - \frac{4\cos\beta}{3\pi} - \frac{4\sin\beta}{\sqrt{3}\pi}\right\}$$

and the heating for a front-tap coil $= 0.487$, giving a rating compared with a six-phase machine of $\sqrt{\frac{0.418}{0.487}} = 92.5$ per cent.

The total average heating for the 120-deg. winding is

$$\frac{3}{2\pi}I_o\int_{-\frac{\pi}{3}}^{\frac{\pi}{3}}\left\{\frac{5}{3} + \frac{2}{3}\tan^2\theta - \frac{4\cos\beta}{\sqrt{3}\pi}[\sqrt{3} - \tan\theta] + \frac{4\sin\beta}{\sqrt{3}\pi}[1 + \sqrt{3}\tan\theta]\right\} d\beta$$
$$= I_o\left\{\frac{5}{3} + \frac{2}{3}\tan^2\theta - \frac{6}{\pi^2}[\sqrt{3} - \tan\theta]\right\} \qquad (21)$$
$$= I_o\{0.62 + 0.607\tan\theta + 0.666\tan^2\theta\}$$

and at unity power-factor $= 0.62\,I_o$.

The permissible rating compared to that of a six-phase machine = 65.7 per cent.

The values of the average heating for various power-factors have also been plotted in Fig. 2 for comparison with the values for machines with symmetrical phases. It is curious to note that the rating actually falls below that of a three-phase machine.

It is interesting in this connection to follow the rapid drop in rating for a very slight change in the power-factor from unity even for average coil conditions. For example, at 95 per cent power-factor the six-ring, four-ring, three-ring and unbalanced-phase machines show respectively only 86 per cent, 87.5 per cent, 91 per cent and 85 per cent of their permissible ratings at unity power-factor.

This tendency is accentuated if it be considered that the ratings depend solely upon the front-tap coil heatings, the corresponding figures at 95 per cent power-factor being

for six-ring, four-ring and three-ring machines 72 per cent, 76 per cent and 79.4 per cent respectively. The more rapid fall of rating of machines of the higher number of phases points to the importance of unity power-factor operation on the maintenance of their relative initial rating advantage. The curves indicate also the rapid

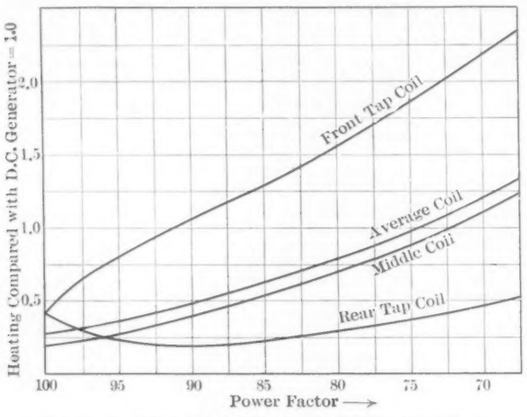


Fig. 6—Heating of Coils of Six-Phase Converter.

approach of all the machines to the same low ratings as the power-factor becomes very bad.

It is interesting to note the power-factors at which the rear tap-coils have the same heating as the middle and average coils. For the middle coils six-ring, four-ring and three-ring machines show power-factors of 96.5 per cent, 92.4 per cent and 86.5 per cent respectively, while for the average coil the figures are 98.2 per cent, 96.5 per cent and 93.7 per cent.

It was stated at the beginning that modern machines are designed to withstand the worst heating in any given coil, and the rapid overheating of these coils at poor power-factors lends emphasis to the insistence of the manufacturers that converters should be operated at or very near 100 per cent power-factor when fully loaded. This contention is strengthened in the case of compounded converters using reactance in the alternating-current circuit of from 15 per cent to 25 per cent with supply line of about 10 per cent reactance to secure flat compounding, for then it

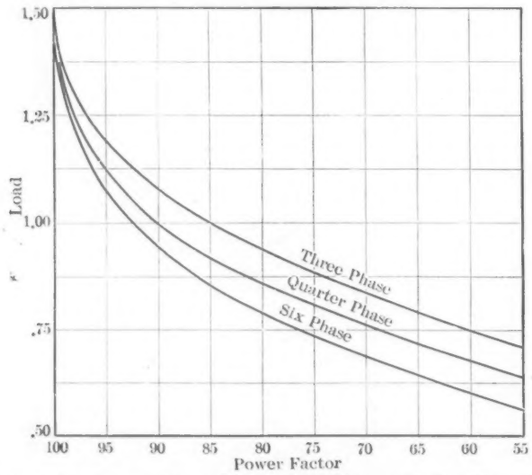


Fig. 7—Loads on Three-Ring, Four-Ring and Six-Ring Converters for Heating Equivalent to 150 per Cent Load, 100 per Cent Power-Factor.

is common practice to secure 100 per cent power-factor at not more than full load, and very frequently at 75 per cent or even 50 per cent of full load. With the latter figures given, the machines of the principal makers in this country would have power-factors ranging from 98 per cent to 95 per cent. If the heating due to this cause is added to that produced by the overload (which varies as the square of the overload) there would be for a six-phase machine at 50 per cent overload and 95 per cent power-factor a total heating in a rear tap-coil (since the wattless current is now leading) of $\frac{0.8}{0.418} \times (1.5)^2 = 4.72$ times that at full load and unity power-factor; for a three-phase machine the figure would be 3.56, the four-ring machine having an intermediate value. It is clear that the machine is in no danger at low loads even at very poor power-factors.

Since it is common practice at present to operate converters for periods of two hours or more at 150 per cent load, Fig. 7 has been plotted to show the loads which may be carried at various power-factors with the same heating in the front tap-coils as exists at 150 per cent load and unity power-factor.

Had the curves been made on the basis of the average heating the slopes would not have been so abrupt, but would have indicated the same tendency. This latter curve may serve as an additional check on the safety of such machines as are arranged for unity power-factor adjustment at high loads and correspondingly low power-factors at lower loads, and, properly interpreted, may serve as a clew to the heating when unity power-factor is secured at lower than 150 per cent loads.

It is hoped that the foregoing may present some new or recall some forgotten facts regarding the amount of local heating that may be expected under various conditions.

REGENERATIVE CONTROL FROM A COMMERCIAL VIEWPOINT.

Monetary Saving to Be Expected When Installing Initially or Substituting Regenerative for Standard Apparatus.

By J. Gustaf V. Lang.

In previous articles[1] fairly reliable conclusions have been reached with reference to the average saving in energy consumption that a regenerative equipment will effect, to the first cost of such an equipment compared with a standard one and, finally, to the comparative cost of repairs and maintenance of the two kinds of equipments. On the basis of these conclusions it is a comparatively easy matter to study the commercial importance of regeneration under different conditions.

Only in the case where a traction company buys its energy at a fixed rate is the full value directly evident. When the traction company itself generates energy the cost of energy as a rule is not figured in such a way that the company could sell to outsiders at that rate and make a reasonable profit. Still, the manufacture of electric energy is really an undertaking by itself and all the interest, depreciation and a certain amount of overhead charges should be given due consideration in arriving at the energy cost figure. If an energy cost figure arrived at in that way is used as the basis, the full value of the energy saving is easy to gage under any circumstances. If this is not done it becomes a next to impossible task to value the influence an energy saving would have in all the different directions. Some would be more easily recognized under certain circumstances than others.

Take, for instance, the case of a new installation; the whole power plant, transmission lines, feeders, number of substations, etc., would be reduced in proportion to the saving. This would mean a reduction in first cost and thus in interest and depreciation. There would be a reduc-

[1] *Electrical World*, March 30, Aug. 12, Aug. 26 and Sept. 16, 1911.

tion in coal, water and labor; the proportion of the reduction in labor would naturally depend on the size of the undertaking. If the cost of energy in the case of the installation of standard equipments had been figured as if the generating plant was a separate undertaking to earn a reasonable profit on the investment, and the energy saving by the adoption of regeneration equipments were figured with that energy cost as a basis, the saving in investment would have received due credit in the energy cost saving. The same thing is true in case of an existing plant. A saving in energy consumption would show a direct saving only in coal and water, but indirectly there is a considerably greater saving. This is evident from the fact that there is a surplus of energy in the same proportion as the saving, which surplus could be sold for other purposes and thus bring a revenue which would be considerably larger than the direct saving in coal and water. Where this surplus cannot be disposed of the saving is equivalent to an increase in the power plant which sooner or later is likely to be of corresponding value for extensions and development of service. Even if this value does not show returns immediately, it is there and it is likely to add to the profits every now and then, when on special occasions extra heavy traffic has to be handled. Besides the saving in coal and water and its handling there is also in most cases a saving in wear and tear on machinery, in oil, waste, etc.

In estimating the cost of energy, inclusive of everything, credit is given to the potential surplus equipment of the station and it is no more than right that this should have due credit. It may be argued that this surplus cannot be utilized for some time and should therefore not be counted. Against this argument stands the perfectly logical argument that the selling price of the energy would be based on the investment values when the existing power station was built, but that, when the point is reached where an addition had to be built, this addition in all likelihood would cost in proportion a great deal more and consequently the saving by avoiding such an addition by the introduction of regenerative control would be considerably greater and make up for the difference between the estimated and the actual saving during the time when the surplus could not be utilized to the full advantage.

When the energy cost is determined on the basis suggested the average cost will be somewhere between 1 cent and 2 cents a kw-hour. At Norwich the cost was claimed to be 1.5 cents and it is a question whether interest, depreciation and a reasonable proportion of the overhead expenses were included in this value since it differs so greatly from the charge made at Blackburn, where the energy was supplied by the Corporation power plant and the street-railway department was made to pay 3 cents a kw-hour.

Since the maintenance figures arrived at in the previous article were based on conditions at Norwich it may be as well to take the Norwich conditions as an example in determining the commercial value of regeneration. The average travel per car per year was 31,600 miles, corresponding to an average speed of 5.5 miles per hour, sixteen hours a day, for 360 days. The average energy consumption was 1.2 kw-hours per car-mile. The total energy expenditure per car per year was thus 38,000 kw-hours. A saving of 25 per cent would amount to 9500 kw-hours, which at a price of 1.5 cents would have a value of $142.50 per car per year.

NEW INSTALLATION.

Considering a new installation of motor equipments the additional cost of installation over and above that called for by the standard equipment has been found to be $405 per car. On this amount would have to be paid interest, at say, 6 per cent, which would mean a yearly charge of $24.30 against the saving of $142.50 in energy and $13 in maintenance. The depreciation would also have to be calculated on an equally greater investment, and thus the yearly contribution to the sinking fund would be increased by 4 per cent (if that were the rate of equipment depreciation) on $405; thus $16.20 should be charged against the saving. The balance then takes the following form:

	Credit.	Debit.
Saving in energy	$142.50	
Saving in maintenance	13.00	
Interest at 6 per cent on $405		$24.30
Depreciation at 4 per cent on $405		16.20
Total	$155.50	$40.50
Balance		$115.00

Thus, after paying for the necessary complications, each car still earns $115 net, which represents the commercial monetary value of regeneration under the assumption of a new installation where the conditions would approximate those at Norwich. The average conditions in America call for heavier cars, higher average speeds with consequent larger motor equipments, higher average mileage per year and a decidedly higher energy consumption per car-mile. Since the brake-shoe maintenance under such conditions increases more than in proportion whereas the motor and controller maintenance increases only slightly, the saving in total maintenance will be considerably greater than in the above example. A commercial energy consumption is around 3 kw-hours per car-mile. The yearly saving in energy per car would then run up to 23,000 kw-hours and more, according to the yearly mileage. Even if the value should be somewhat less than 1.5 cents per kw-hour, figuring in interest, depreciation and overhead expenses of the generating plants and substations, the monetary value of the saving would run up to at least twice that given in the above-mentioned balance. The additional cost of the regenerative equipment over the standard would not be increased very much; certainly 50 per cent would be a safe assumption. Conditions representing more closely the average in this country would consequently modify the balance in favor of regeneration and it would take on approximately the following form:

Saving in energy	$290.00	
Saving in maintenance	25.00	
Interest on additional cost		$37.50
Depreciation		25.00
	$315.00	$62.50
Balance		$252.50

Under average conditions a net saving of $250 per car per annum would be the result of the installation of regenerative instead of standard equipments. Such a saving is in itself well worth consideration, but that is not by any means the only advantage. There are indirect savings which might easily run up to quite a considerable amount. The saving of energy by economical handling of the standard equipment has been recognized, and different methods have been devised to induce the motormen to endeavor to decrease the energy consumption. This result is accomplished in some places by the installation of coasting clocks and a bonus system with its direct expense and additional clerical work. All the different tests described in previous articles and several others besides show conclusively that as far as net efficiency is concerned the regenerative equipment is almost independent of the personal element of the driver. All of the expense to induce economical handling of standard equipments would thus be saved.

The regenerative equipment also eliminates to a great extent the habit that a good many motormen have of applying the brakes before the supply of energy is cut off. It saves the constant banging of controllers "on and off"

in congested traffic. It is often sufficient for the motorman to step back one, two or more notches as may be found necessary. The motorman is enabled to "feel his way," and there is no unnecessary movement of the controller. Moreover, regeneration makes the car practically secure from runaway accidents on down grades as the regenerative braking is automatically "non-skidding."

With the control in one hand instead of two the chances for accidents are considerably lessened, for the motorman has only one thing to think about, one thing to do.

Regeneration also brings with it an advantage the importance of which is increasing as the necessity for very frequent service is becoming felt on rapid-transit lines. In order to cut down the time between stations to the minimum the train should accelerate at the maximum rate allowable without discomfort to the passengers until such a time as, retarding at the maximum rate, the vehicle will be brought to a stop at the next point. If the equipment is not capable of such a high speed as this would necessitate, the next best plan would be to accelerate at the maximum rate to the maximum speed of which the equipment is capable and then run at the maximum speed constantly until a point from which, braking at the maximum rate, the vehicle will be stopped at the desired place. This means that all of the kinetic energy has to be wasted at the brakes; the more these conditions are approached the more inefficient is the standard equipment as compared with the regenerative.

Since, according to present practice, a considerable amount of coasting is being done, it follows that with a regenerative equipment a decidedly higher schedule speed can be maintained without any greater net energy expenditure, so that, besides the saving in energy over the standard equipment, the regenerative equipment is inherently capable of improving the service, the value of which capability it is difficult to express in dollars and cents.

On underground roads the regenerative equipment should be of special value in eliminating almost entirely the dust caused by the brakes and also the heat caused by the dissipation of kinetic and potential energy at the brakes.

SUBSTITUTION.

The commercial value of the substitution of regenerative equipments in place of existing standard equipment depends on circumstances to a considerable degree. There may be conditions, such as the urgent necessity of extension or of improved service without corresponding increase in equipment of the generating station, under which a substitution of equipments would be unusually valuable since an extension of the generating station would thereby be avoided. There might be other conditions, such as the extension of a line where the feeders are too small and where by the use of regenerative equipment the old feeders will be of ample size. Many other possibilities exist whereby the value of such substitution would be enhanced. However, it may suffice to take under consideration only an ordinary case.

In a previous article the cost of substitution of a regenerative equipment of the size used at Norwich was found to be $1,446. A very important question arises here, namely, what part of the new investment should be charged against the saving in energy and maintenance brought about by the substitution? The old equipments had depreciated to a certain extent before they were scrapped and to that extent they should have contributed to a sinking fund for the ultimate replacement of the worn-out equipments. The sinking fund should, therefore, contribute to the cost of substitution to the extent of the value of the depreciation or by the amount to which a yearly 4 per cent contribution on the original cost of the old equipment would have accumulated if placed at compound interest up to the time of the substitution.

Say that the cost of the old equipment was $1,100 and that $44 had to be set aside yearly at 4 per cent interest as representing the depreciation, and that the old equipment had been in use eight years, the sinking fund would amount to $405, and thus the present value of the depreciated equipment to be replaced is in reality $405 less than its original cost, and hence only $1,041 should be considered a new investment, interest on which would be chargeable against the saving.

The balance for the substitution of a regenerative equipment in place of an eight-year-old standard would then be as follows, using the same figures as to yearly energy consumption, cost of energy, etc., as existed at Norwich:

Saving in energy	$142.50	
Saving in maintenance	13.00	
Interest at 6 per cent on $1,041		$62.46
Depreciation at 4 per cent on $405		16.20
	$155.50	$78.66
Balance		$76.84

For the reasons stated in the case of a new installation these figures, if modified to correspond to average conditions in this country, would change the balance to approximately the following form:

Saving in energy	$290.00	
Saving in maintenance	26.00	
Interest		$93.00
Depreciation		25.00
	$316.00	$118.00
Balance		$198.00

Thus in case the old equipment has been in use for eight years the substitution would have a commercial value in favor of it of $200 per car per annum in addition to the many other advantages touched upon above.

Do not the above figures indicate that regeneration is worth while? Would not many a time $200 per car per annum make the difference between success and failure of a traction enterprise? And would not $200 per car per annum quite handsomely increase the net profits of those enterprises fortunate enough to earn any? Then why should regeneration be allowed to lie dormant?

DOUBLING CAPACITY OF EARLY TURBINE PLANT AT DUBUQUE, IOWA.

Several interesting considerations are involved in machinery additions now being made to the steam-turbine plant of the Union Electric Company of Dubuque, Iowa. This station was completed in 1904 and was planned for six 500-kw vertical turbine-generators, four of which were installed. The company is now more than doubling its plant capacity, however, by the installation of a 2500-kw six-stage horizontal Curtis turbine, set in the space provided for the two 500-kw machines. The consumption guarantees for the new unit, approximating 16 lb. of steam per kw-hour, show such a significant gain over the performance of the older and smaller machines that the same boiler equipment will be ample to supply all of the expected commercial-load development of the next year. This increase will be rapid, as the Union company is taking on several new large industrial consumers, notable among them the new factory of the Brunswick-Balke-Collender Company.

The experience at the Dubuque station also points out some of the objections to building too well for the future. As above noted, it was originally intended to install

future fifth and sixth 500-kw vertical turbine in this plant, and foundations for these units were placed at the time the plant was built. To accommodate the new 2500-kw horizontal unit it has therefore been necessary to cut away these foundations, whose reinforced-concrete construction makes this a laborious process.

To supply 500-volt direct-current for the city railway lines a 2300-volt synchronous motor-generator set, running at 514 r.p.m., is also being placed. While the interpole-generator element is rated at only 750 kw, a nominal 1130-kw motor has been chosen to drive it, so that the leading current taken by this unit when operating with over-excited fields will help to improve the station power plant. The plant is located at a point nearly opposite the center of the railway and lighting load. The position occupied by Dubuque at the foot of the river bluffs makes the city area very long and narrow in outline, and the generating station is about 3000 ft. east of the center of gravity of this area.

Mr. L. D. Mathes is general manager of the Dubuque Electric Company, Mr. H. G. Gorr is superintendent, and Mr. R. P. Vivian is chief engineer. Sargent & Lundy, Chicago, are supervising the installation of the new turbine apparatus, and Woodmansee, Davidson & Sessions have charge of the motor-generator and switchboard additions.

Central Station
Management, Policies and Commercial Methods

CENTRAL STATION MONTHLY FOR CINCINNATI.

Beginning with November the Cincinnati Union Gas & Electric Company will issue a monthly publication of interest to its present and prospective customers. Although the embryo magazine is yet without a name, in size it will be about the same as the New York *Edison Monthly*, and will contain forty-eight pages. The initial issue will be 50,000, among the gas and electric customers of the company, all of whose gas consumers are considered good electrical "prospects."

THRESHING BY MEANS OF ELECTRICITY.

Notwithstanding the great advancement effected through the agency of the steam threshing machine, the application of motors to these machines has demonstrated that electricity is much more efficient and economical than steam for this purpose. On a Miami Valley farm owned by William Stroop a motor-driven threshing machine was experimented with in connection with a crop of winter barley. There were 34 acres of barley, averaging 50 bushels an acre, and the average amount of grain threshed per hour while the machine was in operation was 150 bushels. The total yield of the crop was 1700 bushels. A steam-driven engine with a 33-in. Peerless separator was brought to the farm to do the work, but, inasmuch as Mr. Stroop had been using an electric motor about his farm buildings for cutting and grinding feed, sawing wood, etc., it was suggested that the motor be employed instead of the engine. Mr. Stroop's farm is connected with the high-tension lines of the Dayton Light & Power Company, Dayton, Ohio, and the motor, which is shifted to various position as desired, is rated at 15 hp. A test was made while the motor was operating the threshing outfit, which demonstrated that it was drawing 20.5 kw. The total consumption of energy during the process of threshing the 1700 bushels of barley was 220 kw-hours.

ADVERTISING CLIMATE BY ELECTRICITY.

Electricity appears to have found a new sphere of usefulness in the exhibit room of the Los Angeles (Cal.) Chamber of Commerce, in connection with the advertising of climatic advantages in southern California. In order to impress the tourist with the moderate temperature changes found in the lower portion of the State, a bulletin board has been fitted with a thermometric scale, the steps of 10 deg. Fahr. being emphasized by 2-cp incandescent lamps. On the left side of the thermometric scale is an adjustable hand pointer carrying nine miniature incandescent lamps of about ¼-cp rating each, with red bulbs, and on the other side is a corresponding hand pointer equipped with blue lamps. Above the scale an electrically illuminated sign descants upon the charms of climate at San Diego, the highest temperature for the preceding day and the lowest temperature reading for the current date being shown by the electrically lighted hands below. The bulletin is about 7 ft. high by 30 in. wide and, in electrically emphasizing the point that San Diego has the shortest thermometer in the United States, it attracts much notice. The lamps are supplied by local central-station energy.

SUCCESSFUL HOUSE-WIRING CAMPAIGN IN WICHITA, KAN.

During a recent sixty-day house-wiring campaign conducted by the Kansas Gas & Electric Company 400 new contracts were closed. In the course of the campaign, which actually comprised only fifty-two working days, advertisements were carried in the local papers describing three special house-wiring propositions, for which the company arranged with the local contractors. The customer signed an agreement in favor of the company, promising to pay the amount in twelve equal instalments, without interest. These installations were estimated at the lowest possible rates and the company paid the contractors cash as soon as the consumer accepted the wiring and signed the agreement in favor of the company. In addition to the 400 contracts closed at least 100 other prospective customers were stirred to the point of applying for service.

Four salesmen were employed for forty-five days and three for the entire campaign. For each 100 contracts closed by a salesman the company paid a bonus of $25. At a conservative estimate this campaign will increase the company's gross income about $7,200 per year, or an average of about $18 per year per customer, not counting revenue on appliances sold.

The campaign has increased the appliance output very materially, the sales including 154 irons, ten washing machines, four vacuum cleaners, nineteen toasters, two percolators, three curling irons, one shaving mug and two sewing-machine motors; in addition there were placed on trial ninety-eight irons, six washing machines, two vacuum cleaners and six toasters. The record has been 90 per cent of sales on all trial orders.

Figuring advertising, soliciting and all expenses of securing the forty new contracts and selling and placing on trial the appliances, it cost the company $3.12 for each new customer. The campaign was in charge of Mr. Malcolm A. Smith, sales agent. Mr. H. S. Sladen is manager of the company.

MAKING MONEY OUT OF A BRICK WALL.

The value of an exposed brick wall surface as a means of central-station publicity is illustrated unusually well in the case of the Pacific Gas & Electric Company and its affiliated organization, the San Francisco Gas & Electric Company, occupying a modern office building near the center of the city's business area. The south wall of the building faces a vacant lot bordering on Sutter and Powell Streets, and recently the company's officers decided to turn the space to account for the purpose of acquainting the public with the magnitude and resources of the generating and distributing systems, the latter covering an area of 32,431 sq. miles and representing probably the largest single transmission enterprise in the world. The wall of the building is now occupied with a map of California showing in colors all important localities and physical features of the State, transmission lines, railways and waterways, and bearing the legend that the map illustrates the largest distribution system existing for electric light and power service. Above the map are four signs stating that the organizations are pioneers in hydroelectric development in California; that mining, manufacturing, irrigation, reclamation, transportation and all other industries are furnished with energy at the lowest rates; that power experts are at the service of the public without cost, and that the organization now employs 3500 people, operates fourteen power houses, eighteen gas plants and supplies 235,000 consumers in 209 cities and towns. Statistics are given below the map of the area served and the population tributary to the system, and near the ground are given the decreasing prices of gas for the last eleven years. The map and supplementary signs occupy seven stories and are about 50 ft. wide. Officers of the commercial department state that the success attained by thus utilizing this otherwise barren wall has been little short of remarkable.

NEW SCHEDULE OF RATES FOR ST. LOUIS.

Effective on the first meter reading after Oct. 20, the Union Electric Light & Power Company, of St. Louis, announces a radical revision in rates for electrical energy. The new primary rate for residence lighting is 11 cents a kw-hour, instead of 12 cents, and in addition there is a secondary rate of 6 cents a kw-hour for all energy used in excess of that paid for at the primary rate.

This announcement of the new rates of the company, made Oct. 15, follows the decision of the Public Service Commission of St. Louis that the central-station rate for electrical energy in that city shall be a flat rate of 9½ cents. The company declares that its new rates of 11 cents and 6 cents will work out lower for the average residence than a flat rate of 9½ cents, and the commission's ruling will be contested in the courts.

"ACTIVE-ROOM" PLAN OF RESIDENCE CHARGING.

In residences the primary rate of 11 cents applies to the first 4 kw-hours consumed per month for each of the first four "active rooms" of the house or apartment. All rooms except three bedrooms, bathrooms, basement, garret, closets and porches shall be counted as "active." The primary rate of 11 cents also applies to the first 2½ kw-hours consumed each month for each of the "active rooms," in addition to the first four. The secondary charge of 6 cents a kw-hour applies for all energy used in excess of that paid for at the primary rate in all rooms which are counted as "active." The monthly minimum shall be $1, and a discount of 5 per cent is allowed for prompt payment.

An average eight-room house may consist of a living room, dining-room, reception hall, kitchen and four bedrooms. The old rate, based on a consumption of 35 kw-hours per month at 12 cents, would be $4.20; deducting 5 per cent leaves $3.99 as the net monthly bill, or at the rate of 11.4 cents per kw-hour. The new rate for such a house, it is asserted, would be something like this:

First 4 kw-hours for first four active rooms, 16 kw-hours at 11 cents	$1.76
One active room, first 2½ kw-hours at 11 cents	.27
Excess 16½ kw-hours at 6 cents	.99
Total	$3.02
Less 5 per cent	.15
	$2.87

Thus the average net rate for the 35 kw-hours consumed under the new system of charging would be 8.2 cents. It is expected that the establishment of the low secondary rate will make attractive the use of electrical conveniences, such as toasters, flatirons, radiators, electric cooking devices, etc.

COMMERCIAL LIGHTING.

For commercial lighting the new schedule provides for a demand charge (paid in equal monthly instalments) of $42 a year for each kilowatt of demand of the first 20 kw, $30 a year for each kilowatt of the next 40 kw, and $24 a year for each kilowatt of demand in excess of 60 kw. In addition there is an energy charge of 5 cents a kw-hour for the first 1000 kw-hours used during the month, 3 cents for the next 5000 kw-hours and 1½ cents a kw-hour for all energy consumed in the month in excess of 6000 kw-hours.

"Demand charge" is defined as a charge for the consumer's greatest requirement of energy for any continuous period of 15 minutes. "Energy charge" is defined as a charge for electricity consumed as shown by the meters. The maximum rate of charge for service during any month in an installation having a demand of less than 30 kw shall be not greater than 11 cents a kw-hour, with a minimum bill of $1. Both for commercial lighting and in residences the rates given include free lamp renewals of standard carbon lamps. In commercial lighting a deduction of ½ cent per kw-hour is optional in the case of customers having demands of 30 kw and more who desire to furnish their own lamp renewals.

INDUSTRIAL SERVICE.

In the case of power service the rates given for commercial lighting apply with a deduction of ½ cent a kw-hour where the service is used for the operation of motors and where the demand is 30 kw or more. The demand upon which the monthly demand charge is based shall never be less than 75 per cent of the maximum demand occurring at any time during previous months of the contract under which service is furnished. An alternative power rate, which may be selected at the option of the customer, is provided as follows: 10 cents a kw-hour for the first 100 hours during the month, 8 cents for the next 100 kw-hours, 6 cents for the next 100 kw-hours, 4 cents for the next 300 kw-hours, and 3 cents a kw-hour for all energy used in excess of 600 kw-hours during the month.

DETERMINATION OF DEMAND.

In the application of the rates the consumers' demand shall be determined by assessment or measurement as follows:

Commercial Lighting Service.—(1) In installations of 2 kw connected or less demand shall be determined as 100 per cent of all display lighting; 100 per cent of the first 300 watts connected, plus 66⅔ per cent of the connected load, in addition to the first 300 watts of the entire illumination, exclusive of display lighting, except where tests indicate the demand to be larger than that computed on this basis. (2) In installations greater than 2 kw connected the demand shall be measured.

Motor Service.—The demand of the consumer using the company's service for motors shall be determined as the maximum rate at which energy is used for any continuous period of 15 minutes as shown by watt-hour meter.

The rates given apply on yearly contract. For consumers obtaining service for a period of less than a year

the charge for such electric service shall be 11 cents a kw-hour, with minimum monthly bill of $1. In this case the consumer shall pay the cost of connection and disconnection and installation and removal of meters. In case the consumer's gross bill for the period is $50 or more the meter charge and connection and disconnection charge shall be refunded when service is discontinued. The discount for prompt payment is 5 per cent on the first $25 of all bills; on amounts in excess of that the discount is 1 per cent.

UNIQUE PLAN OF CINCINNATI'S NEW RATE SCHEDULE.

The new schedule of rates for electric service from the lines of the Union Gas & Electric Company, of Cincinnati, which went into effect Oct. 15, embodies a number of rather advanced points in central-station relations with the public.

In the first place, the printed schedules of the company, with statements of all conditions, riders, etc., and general information to customers, are arranged in booklet form, into which is bound the customer's duplicate of his contract, the original being kept by the company. This thirty-two-page schedule booklet is of standard document size, 4 in. by 9 in., so that it can be filed if desired. With a single motion in this way the company places in permanent form in the consumer's hands both its contract and rule book, inviting the fullest study of its rates to all its customers and insuring that the rule book will be preserved with the care given the contract.

Service under the new rate schedule is divided into eight classes, lettered A to H, limiting which are fourteen standard "riders" or clauses, which are noted down and agreed to in the contract blank and fully explained on the following pages of the booklet.

In general the new Cincinnati schedule involves a small revision downward of the former rates. A monthly "maintenance and inspection charge" of $1 per kilowatt of lighting demand and 75 cents per horse-power of motor demand is now made with the approval of the Public Service Commission, this charge being waived when the monthly bill, based on the kw-hours consumed, exceeds its amount. For residence lighting 70 per cent and for business houses 90 per cent of the connected load is taken as the demand. The motor demand ratio ranges from 90 per cent under 5 hp to 55 per cent over 100 hp, all elevator motors being estimated at 60 per cent of their rating. Five per cent discount on all bills is allowed for payment within five days of date rendered.

Schedule A, relating to residence lighting, is based entirely on the equivalent hours' use of the maximum demand, and involves a graduated number of successive steps, awarding a premium to the long-hour user. It is expressed as follows:

Hours' use of maximum demand.....	30	40	50	60	90	120	150	180	210	240	270	300
Rates in cents per kw.-hour.	10.00	9.25	8.80	8.50	7.00	6.25	5.80	5.50	5.29	5.12	5.00	4.90

Ten cents per kw-hour is charged for all below thirty hours' use of the maximum, and in application intermediate quantities are found by interpolation. For the use of the accounting staff tables have been worked out, giving those intermediate figures directly. Bills showing ninety hours' use of the maximum are allowed 10 per cent discount, plus a discount of one-tenth of 1 per cent for each dollar in excess of $10. Small motors, domestic heating appliances, etc., are not considered in estimating the maximum-demand element of the bill.

Schedule B applies to commercial lighting. Starting at 10 cents the rate reduces to 4.9 cents, as under Schedule A, Where the total consumption exceeds 1500 kw-hours in any month the charge will be made on the basis of the wholesale schedule, E.

Schedule C relates to patroled advertising lighting, including lamp renewals, etc., the signs being illuminated from dusk to midnight every night in the year.

RATES IN CENTS PER LAMP PER MONTH.

Number of Lamps in Installation.	4-CP LAMPS. Regular Rates.		4-CP LAMPS. Flasher sign rates: Lamps dark from 25% to 49% of lighting period.		4-CP LAMPS. Flasher sign rates: Lamps dark for 50% and over of lighting period.		2-CP LAMPS. Regular Rates.	2-CP LAMPS. Flasher sign rates. Lamps dark from 25% to 49% of lighting period.	2-CP LAMPS. Flasher sign rates. Lamps dark for 50% and over of lighting period.
	Car.	Tung.	Car.	Tung.	Car.	Tung.	Carbon.	Carbon.	Carbon.
20– 50	26	22	23	20	18	18	18	16	12
51– 100	26	20	23	19	18	18	18	16	12
101– 200	23	19	20	17	16	16	16	14	10
201– 300	20	17	17	16	14	14	13	11	8
301– 400	18	16	15	14	12	12	12	10	7
401– 500	17	15	14	13	11	11	11	9	7
501– 800	16	12	13	11	10	10	10	8	6
801–1000	15	10	13	9½	10	9	10	8	6
1001–2000	14	9½	12	9	9½	8½	9½	7½	5½
Over 2000	13	9	11	8½	9	8	9	7	5

Under Schedule D the company installs and operates private tungsten curb-posts, $7 for each post having five 60-watt lamps, or $6.25 for each post containing one 250-watt lamp, being the monthly rate for dusk-to-midnight service. Series arc lamps operated all night long cost $5 per month in the underground district and $5 in the overhead section.

In arranging Schedules E and H for wholesale lighting and motor service a premium has been placed upon long-hour use rather than quantity consumed. The published wholesale lighting schedule ranges from the ordinance rate of 10 cents down to 1.88 cents per kw-hour for a consumption of 50,000 kw-hours used during 300 hours' equivalent. Schedule H similarly ranges from 9.02 cents for 1000 kw-hours at thirty hours' use down to 1.50 cents per kw-hour for 50,000 kw-hours at 300 hours' use.

Schedule F, for retail "power" (consumption under 1500 kw per month), is as follows, with the same discounts as Schedules A and B:

Equivalent hours' use of maximum demand....	30	40	50	60	90	120	150	180	210	240	270	300
Cents per kw.-hour.....	10.00	9.00	8.40	8.00	6.33	5.50	5.00	4.67	4.43	4.25	4.11	4.00

Schedule G, for private garages, allows the "power" rate with a demand factor of 60 per cent of the capacity of outlets. For public garages a further discount of 10 per cent is allowed for off-peak restrictions during the winter months.

The standard "riders," which are noted on the contract and agreed to, relate to matters of auxiliary service, with and without off-peak restrictions; summer service; annual cut-out; service not including winter months; fans; temporary service; termination by sale or lease; old and new buildings; receiverships; weekly payment; tenant's own meters; total consumption of several meters and lighting from power circuits. In arranging this schedule and its limitations by "riders," which can be referred to easily by number, the effort has been to make clear to each cus-

tomer interested what any other customer pays for his service.

The closing pages of the booklet include the local electrical regulations and information for customers on matters of equipment, complaints, meter reading, wiring, etc., with examples applying the new schedules.

Mr. Rollin W. White has been acting president of the Cincinnati Union Gas & Electric Company, and Mr. J. W. Lyon is commercial manager of the electrical department.

Wiring and Illumination

A RECORD RUN OF A RECTIFIER TUBE.

One of the rectifier tubes in the Louisville (Ky.) magnetite street-lighting service recently brought to a close its extraordinary life of 7176 hours and 23 minutes in actual operation. This tube was started May 30, 1909, and taken out of service Feb. 17, 1911. During these 627 days the arc circuits were in operation 7919 hours, but, as the rectifiers are given a preliminary run of fifteen minutes each day, this particular tube was in use a total of 7176 hours. The rectifier tubes in service at Louisville ordinarily average lives of 700 hours to 800 hours each, being guaranteed for 500 hours. Louisville's equipment of magnetite arc lamps was the first large installation put into service. Nearly 2600 of these 4-amp lamps are in use there, supplied by rectifier outfits of the air-cooled type originally furnished.

COST OF LAMP CLEANING IN A LARGE ESTABLISHMENT.

A large office and mercantile establishment having many hundreds of artificial lighting units of various types has among other systems one of indirect lighting using units consisting of tungsten lamps of the 150-watt size in one-piece corrugated mirror reflectors. The cost of cleaning these lamps and reflectors in the ordinary routine of the place is 2.6 cents per unit.

Tests made on an office lighted in this way showed the reduction of 72 per cent in illumination due to dirt on lamps and reflectors after four months without cleaning. From these figures it is easily to be estimated that at any ordinary cost of electrical energy cleaning once a month would be justified by the saving in light involved. This test was made in offices located in a residence and manufacturing district of a large Western city and represents neither the very worst nor the very best condition encountered in cities where soft coal is extensively used. If more large concerns would carefully analyze the cost of cleaning and the cost of light lost by dirt on lamps and reflectors it is very probable that more frequent cleaning than is now common would be the rule.

EFFECT OF REFLECTION FROM FLOORS.

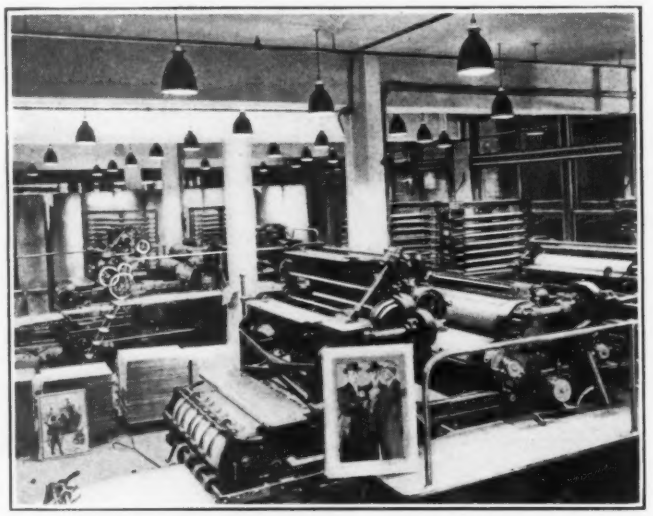
By J. R. Cravath.

The important effect of reflection from ceilings and walls is now fully recognized in illumination design, but the effect of reflection from the floors is commonly ignored. That such reflection is an important factor was plainly shown by the results of tests presented to the convention of the Illuminating Engineering Society in 1908 by Messrs. V. R. Lansingh and T. W. Rolph. The tests recorded in that paper, however, proved that the color of the floor has less effect on the illumination of a given horizontal plane than has the color of the ceiling or walls. This might be expected from a theoretical consideration of the subject.

Probably the reason that reflection from floors and differences in illumination effect with floors of different colors has been generally ignored is that it is frequently difficult to know in advance what the color of the floor will be in actual use. In many cases even if the floor is light in color at the start it will soon become darker with use, and hence a dark floor is assumed initially.

The writer has in mind a certain large ballroom in Chicago where the effect is totally different when the light, natural finish of the wood on the ballroom floor is covered with dark canvas. This room is used at times as an audience room, and the dark floor cover is laid for such occasions. With the light floor the illumination of faces is remarkably good. With the dark floor covering there is a decided decrease in the illumination from below, and faces appear much darker. The walls are poor reflectors.

Another interesting case of reflection from below is to be found in dining-rooms which are lighted with a heavy art-glass dome over the table, there being no other source of light. It has been frequently noticed that such rooms appear very well lighted when there is a white tablecloth



Illumination of Ceiling by Reflection.

on the table, but the illumination of the room is much less when the cloth is removed.

The most striking illustration of the effect of reflection from below on the illumination of a room which has come under the writer's notice is illustrated in the accompanying photograph of a section of the printing department of Sears, Roebuck & Company's plant in Chicago. In this case all of the lighting is by opaque reflectors of the deep beehive type, each consisting of one piece of corrugated mirrored glass. The remarkable thing about this installation is the amount of light on the ceiling, in spite of the fact that opaque reflectors are used. The photograph was taken by artificial light and has not been retouched. The illumination of the ceiling is, of course, obtained by reflection from the light-colored floors and from the large quantities of paper stacked up about the presses. The effect is altogether much more cheerful than one would expect for an installation where all the light is obtained from deep opaque reflectors.

The physical efficiency of an installation of this kind is very high because the light on the working plane is obtained principally from the lamps themselves and from very efficient reflectors. On account of the high efficiency of such installations they will always find considerable use, especially in places where there is considerable dirt, as in various industrial establishments. As far as the shading of the lamps from the eye is concerned these deep reflectors go about as far as is practicable with any direct system of

lighting. As to efficiency and shading of lamps, therefore, an installation of this kind is good. The chief objection to it is the fact that most of the light at any given point is received from one light source. This means poor diffusion and unidirectional light, which cannot fail to result in more annoying glare from the paper and polished metal of the presses than with a system where the diffusion of light is better and light is received from many directions at any given point.

The system under discussion was selected by the employees as the most satisfactory after trying several systems. Under the conditions of the trial, however, it would be difficult to say how much the judgment of the employees was influenced by the higher intensity of illumination obtained with this system as compared with the others. However, the watt consumption of the present system is less than those of the others tried in competition with it, which gave better diffusion. The annoyance caused to workmen by glare from paper and presses is doubtless less than would be caused by glare from papers and desks in general office work.

In the installation illustrated the lamps are 12 ft. 7 in. above the floor and the ceiling is 16 ft. high. The ceilings and walls are white, except that the walls are painted black to a distance of 6 ft. above the floor. The bays are 16 ft. x 20 ft., and each bay contains five lamps, one in the center of the bay and one in the center of each of the four quarters of the bay. No measurements have been made of the efficiency to determine the percentage of lumens generated which reached the working plane. It is known, however, that the illumination is from 3.5 ft.-candles to 7 ft.-candles.

DECORATIVE STREET LIGHTING AT HAMILTON, OHIO.

Hamilton, Ohio, is still congratulating its merchants on the acquisition of a handsome new downtown decorative lighting scheme installed by the city and operated at the expense of the adjacent tenants and business houses. About sixty of the posts are installed, most of them on

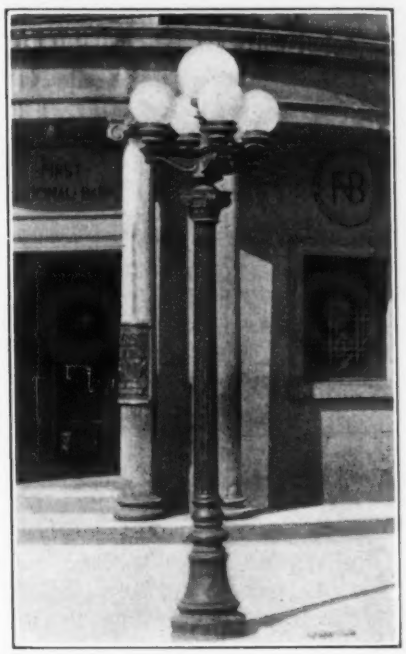


Fig. 1—Type of Tungsten Post Used at Hamilton, Ohio.

High Street, the main business thoroughfare. The standards are of Corinthian design, and each carries five 60-watt tungstens inclosed in frosted globes, all lamps turned upward and at a height of about 10 ft. from the sidewalk, securing a very even distribution on the street surface. The cost of installing the standards, about $80 each, was defrayed out of the city funds, and for the operation of the lamps the abutting property owners or tenants are

Fig. 2—Tungsten Standards at Hamilton, Ohio.

assessed $1 per front foot per year. This amount is collected by the municipal lighting plant in twelve monthly payments. The local Commercial Club has been behind the project of Hamilton's decorative lighting and has secured the co-operation of the merchants. Later it is probable that the operation of the downtown lighting will be taken over by the city as part of the regular street light-

Fig. 3—Night View of Hamilton Decorative Lighting.

ing. This decorative lighting, together with a large part of the local commercial and residence lighting, is done by the Hamilton municipal plant, of which Mr. J. O'Toole is superintendent.

RECENT TELEPHONE PATENTS.

SAFETY CROSSING.

Where high-tension energy-transmission wires cross telephone or similar lines some special safety measure must be provided to prevent accidental contact. Special cradles have been used to a large extent, the cradles being hung parallel to and beneath the uppermost of the lines. Mr. C. J. Elliott, of Oxnard, Ontario, Canada, has devised and patented a different sort of protective means for those cases where the transmission wires are above. He provides a metallic ring to surround each high-tension wire. This ring is supported from the cross-arm at some distance out along the span. Each ring is connected to a wire at a different potential from the one it surrounds. If any wire break and slacken it comes in contact with its ring and burns off, the dead section thus formed dropping to the ground.

PRIVATE EXCHANGE SYSTEM.

Mr. A. D. T. Libbey, of Elyria, Ohio, has patented a combined intercommunicating and private exchange system, his patent being assigned to the Dean Electric Company. A key set is provided for each station and by this means any station may select and call any other. One key at each station is connected to a central office line and one station is chosen and equipped as a call-receiving station. This station is provided with a switch which enables the trunk or exchange line to be held while a call is being extended to the desired station. The answering of the desired station automatically releases the holding switch.

SWITCHBOARD CIRCUIT.

A switchboard with a universal cord circuit forms the subject of a patent granted to Messrs. C. S. Winston and E. H. Rupe, of Chicago. It is intended to terminate both magneto local-battery and common-battery lines upon this switchboard and the cord circuit is automatically adapted to suit whichever type of line it happens to be associated with. The Kellogg Switchboard & Supply Company has obtained this patent through assignment.

MOUTHPIECE.

A mouthpiece for transmitters patented by Mr. P. B. Clarke, of Liverpool, England, is designed to contact with the face of the user to prevent the escape of sound. The edge of the mouthpiece is shaped specially and carries a flexible strip. The walls of the mouthpiece are double, the intervening space being filled with fibrous material, a non-conductor of sound.

SELECTIVE RINGER.

A ringer for selective signaling is described in Mr. H. L. Johnson's patent. A ringer of the usual polarized type is provided with a third core parallel to the main cores. This carries a pole-piece in position to affect the polarity of the main cores. It carries an attachment to the yoke of the magnet and a magnetizing coil. This coil is connected either to the same side of the line as the ringer or to the opposite side, as the case may be, and by applying direct current to the line simultaneously with the alternating ringing current the auxiliary pole either opposes or assists the ringer action in a manner to permit selection.

METHOD OF WIRING.

With automatic apparatus each set of trunks between the various selectors must be of sufficiently large number to provide for the busiest moment. Thus the first trunks of a group are continuously busy, while the last are engaged only at rare intervals. To right this and to reduce the total number of trunks the selectors of any stage may be divided into groups and then the trunks may be connected to different groups in different sequence, some trunks skipping some groups altogether. Mr. E. A. Gray, of Boston, has patented this wiring system and assigned his patent to the American Telephone & Telegraph Company.

LETTERS TO THE EDITOR.

The Central Station and the Electric Vehicle.

To the Editor of Electrical World:

Sir:—From the editorial in your issue of Oct. 14 commenting on the recent convention of the Electric Vehicle Association of America I am very sorry to get the impression that there seems to exist an idea that in some mysterious way, and not altogether to their own interest, the central stations of the country are being expected to "pull the chestnuts" from the fire for the benefit of other industries interested in the present and future of the electric vehicle. The *Electrical World* is the beacon light of the electrical interests of the country, and whoever else may have a misconception on this subject, it is particularly to be deplored in that periodical.

It is perfectly true that just at present the central stations are showing a very extraordinary and very able activity in introducing and spreading the use of the electric vehicle. This is true, partly, because the introduction of the electric vehicle means a more continuous profit to the central station than to anyone else at interest.

A recent authentic report states that if electric energy were used to deliver all the railway freight now delivered by teams in Boston 76,500 kw-hours a day would be required; at 5 cents a kw-hour this would mean an increased revenue of over $1,100,000 a year to the source of energy supply for service at least 60 per cent of which is rendered during the off-peak period. It would be very hard to find any proportionate beneficiary in any other division of industries interested in the electrical vehicle.

Another excellent reason why the central station ought to be, and is (much to the credit of its foresight), in the forefront of the work of introduction of the electric vehicle is that of all the allied interests it is best situated to meet the conditions as they are at this particular moment. For practical purposes the engineering problems are solved. The progress of introduction depends on the conversion of the teamster and team owner. The strongest local electric-vehicle interest that comes in contact with this class is the central station, and frequently, and usually, in a judicial attitude. And don't imagine for a moment that the other electric-vehicle interests have not borne their share of the burden. It is extremely doubtful if the central stations, with all their power, could have been of any conspicuous service until the last three or four years. The problems to be solved were not the kind to which they could conveniently and profitably set their hands. It needs no political economist, or even an experienced business man, to know that every electric-vehicle manufacturer, or manufacturer of storage batteries or motors, who had the foresight and courage to attack the problem during the last fifteen years has been absolutely compelled to spend every cent he could rake and scrape together and every foot-pound of effort he could spare, to do that missionary work which would alone tend to precipitate the general introduction of his product in time to justify his attempt at all.

Your reference to the sore need of operating data is hard to account for. Of reliable operating data there is information by the ream. Successive collectors and compilers of operating data have been successfully and wastefully confirming each other for at least five or six years, and will continue to do so as long as each successive entrant into the work is perfectly satisfied that he is *"the* pioneer."

It is true that at the convention there were "blows" given and "blows" taken between the representatives of the manufacturers and the representatives of the central stations, but it didn't take a keen observer to see that the majority of them were more than half in the spirit of banter. It took no experienced eye to see that the convention as a whole was not interested in the always futile search for scapegoats for the past.

Now, the Electric Vehicle Association of America is an extraordinarily harmonious organization; the co-operation therein is as fine as in any trade association I have ever been acquainted with. The sole reason why the central stations appear to-day to be bearing the brunt of the battle is because the nature of the fight makes it "their turn"; they are the most qualified to make the greatest headway at this particular moment, but this does not entail any relaxation of effort on the part of others—in fact, they cannot relax and live.

Cleveland, Ohio. Hayden Eames.

[The lack of harmony on which we commented is natural in the first stages of co-operation of commercial interests as diverse as those concerned in exploiting the electric vehicle, and will, we hope, in time give way to "team

work." As to operating data, our remarks referred more particularly to the lack of published data of an authoritative nature readily available for reference, and relating not only to the electric vehicle, but also to the comparative cost of horse transportation. We quite agree with our correspondent that the progress of introduction of the electric vehicle depends on the conversion of the team owner, but such conversion will in turn depend largely upon comparative showings of costs based on data that will be accepted as disinterested.—ED.]

Visual Acuity as Affected by Pupillary Contraction.

To the Editor of Electrical World:

SIR:—In the article by M. Luckiesh in your issue of Aug. 19, on "Monochromatic Light and Visual Acuity," the author states that he attempted to make his investigation practical, and it is therefore unfortunate that an acuity comparison between the mercury-vapor tube and the tungsten lamp was not made, as this was what prompted Dr. Bell's article in the issue of May 11, to which Mr. Luckiesh refers. Such an investigation, however, would have necessitated employing heterochrome photometry, which Mr. Luckiesh tried to avoid, simplifying his conclusions. One factor relating to Bell's and Luckiesh's conclusions is whether the pupil has any bearing on acuity of vision.

This was called to the attention of Dr. Bell by the writer in the issue of June 8, and the following week he replied that an artificial pupil was used. Luckiesh, likewise, made simultaneous measurements with both eyes. Also observations taken with a lens of the pupil indicated no change, from which he concluded:

"This shows that pupillary contraction is not the explanation."

Concerning these conclusions that the size of the pupil has no bearing on acuity, the writer would like to see further evidence offered before the statement is accepted as a scientific fact. Many investigators believed that the pupil had some bearing on acuity, as shown by attempts to eliminate the pupil as a factor. The practice has been to vary the diameter of the pupil with atropine, pilocarpin, etc. In a paper presented before the Boston Section of the Illuminating Engineering Society and printed in the *Transactions* of May, 1909, the writer said:

"Hummelsheim made a study of the relation of the size of the pupil to visual acuity. He varied the diameter of the pupil with homatropin, atropine and pilocarpin. He states that the absolute size of the smallest visual angle decreases if the opening of the pupil or of the diaphragm held before it becomes less."

This would, therefore, be an objection to using an artificial pupil, although maybe the use of myotics or mydriatics might have indirectly produced the results noted.

We also find the following from Cobb, in the Johns Hopkins lectures, Vol. II, page 551:

"Further, other factors, such as small errors in refraction or changes in the pupil, will outweigh large changes in light intensity. A small diaphragm (say, about 2 mm. diameter) put before the eye, although at the same time cutting down the brightness of the retinal image, will usually increase the distinctness of vision."

Referring again to the Boston paper:

"Hummelsheim refers also to Klein, in Paris, 1873, who also studied the influence of the narrowing of the pupil on acuity of vision."

Schiemer[1] states:

"The influence of the width of the pupil is extremely small with the smaller illuminations. From one meter-candle up keenness increases with narrower pupil. From 50 to 200 candles the difference increases very little."

Messrs. André, Broca and F. Laporte[2] state:

"The contraction of the pupil depends on the intrinsic brightness of the luminous source. The mercury vapor arc, which has a low intrinsic brightness, does not follow the above rule, but causes a very sharp contraction of the pupil."

We find the following in Tscherning[3], which supports Mr. Luckiesh:

"It is not alone the light which strikes the retina of a particular eye, but also that which enters the other eye, which causes contraction (referring to movements of pupil). The pupils are equal in size, even if one eye is exposed to a much stronger light than the other."

This statement, however, should not be construed as implying that Tscherning did not believe that the size of the pupil had any bearing on acuteness of vision, for we also find the following[4]:

"Visual acuity depends directly on the illumination of the chart, but it is quite difficult to determine the relation in a general way, because there are so many different factors which affect it. Thus, the relation must depend on the pupillary size, on the manner in which the pupil contracts under the influence of light, etc."

Where an attempt is made to eliminate the pupil from affecting acuity measurements by using mydriatics and myotics the effect on the accommodation of the eye is such that it probably affects the results. Norris and Oliver[5] state as follows (page 31):

From Snellen.—"If there has been permanent tension of accommodation it gives way under the influence of the mydriatic, and the farthest point of distinct vision moves farther from the eye than it would in simple relation without the aid of such substances." (Page 587.)

"Unlike that of the mydriatics, the action of the myotics does not render the pupil immobile. During the period of diminution of the action of the myotic the range of accommodation is absolutely increased, the influence on the near point being greater at that time than on the far point." "Objects also appear more strongly illuminated to the atropinized eye than to the fellow eye." (Page 41.)

"To the eye to which the myotic has been applied objects appear much less brightly illuminated than to the other eye."

Regarding readings taken with both eyes simultaneously with a view to eliminating the effect of the pupil, we could conceive of a case where an individual's eyes had been corrected with glasses, both eyes having the same measure of optical perfection, but it is difficult to conceive of how the eyes would possess the same individual fatigue simultaneously, and fatigue plays an important part in our acuity, as can be proved experimentally. With regard to measuring the diameter of the pupil, Luckiesh states that he observed no change. This indicates to the writer a repetition of his early measurements, in which a lens, a mirror and a glass scale were used. It was found that it was difficult to note any decided change in the size of the pupil. Later on apparatus was used, developed by D. H. Rice, the writer's associate at that time. A pair of cross-hairs was used in conjunction with a small concave mirror having a radius of curvature of 2 in. One of the cross-hairs was fixed[6], the other movable. Any movement of the movable cross-hair was magnified by means of a simple lever passing over a scale. A clear image of the pupil resulted, whose variation in size was readily measured. A difficult thing to determine was what criterion to use as the proper size of the pupil to measure, as it kept changing

[1]"Untersuchungen zur Physiologie der Pupillen-weite," *Archt.-Opth.*, Band XL. 5, p. 8.

[2]*Bulletin* de la Societé Internationale des Electriciens, June, 1908.
[3]Tscherning, "Physiologie Optics," p. 212.
[4]Tscherning, "Physiologie Optics," pp. 214, 215.
[5]Norris and Oliver, "System of Diseases of the Eye," Vol. 11, p. 31.
[6]*Electrical World*, Feb. 25, 1909, p. 497.

continually. Tscherning[7] attributes this movement to action of blood vessels, for he says:

"On examining the pupil with magnifying glasses we observe rhythmic contractions which at least in part correspond to the systole and which are due to the fact that the vessels are continually filling with blood."

It would be quite difficult to use this apparatus and make acuity measurements at the same time unless the test type was made in the form of a lantern slide, as used by Dow[8], and readings of acuity and size of pupil taken simultaneously.

Concerning the use of the flicker photometer, to which Mr. Luckiesh refers, in view of the proof presented by Dr. Woodworth[9], of Columbia University, before the Illuminating Engineering Society, in which three relative brightness curves were shown superimposed, obtained by three different optical methods, one of which was a flicker measurement, it is hard to see the need of any further proof.

In discussing Mr. Millar's paper on "Heterochromatic Photometry"[10] in 1909, before the Illuminating Engineering Society, the writer called attention to the desirability of having such proof, and it is interesting two years later to notice this proof forthcoming.

Harrison, N. J. S. W. Ashe.

[7]Tscherning, "Physiologie Optics," pp. 214, 215.
[8]*Ill. Eng. London*, April, 1909, Vol. II, No. 4, p. 234.
[9]*Trans.* Ill. Eng. Society, May, 1911, p. 459.
[10]*Trans.* Ill. Eng. Society, Vol. IV, 1909, p. 782.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Polyphase Commutator Motors for Regulating Induction Motors.—A. Scherbius.—An article on the system of Brown, Boveri & Company for regulating the speed of an induction motor by cascade connection of the induction motor and a polyphase commutator motor. The commutator motor has a compensation winding on its stator. Either shunt or series excitation is used as in direct-current machines. The emf's produced are proportional to, and in time-phase with, the fluxes. In the cascade connection the rotor of the induction motor must have a slip emf equal and opposite to the emf impressed on it from the commutator motor—that is, the speed of the induction motor must drop by a corresponding amount. By changing the excitation at will it is possible to provide any number of steps for the speed regulation. Further phase compensation is at once possible. Any number of combinations of the excitation winding may be made and the phase difference between excitation current and rotary emf may thus be adjusted. This is possible with shunt, series or compound excitation. The commutator machine absorbs the energy for regulation as electrical energy and transforms it into mechanical energy, which may be utilized in any number of ways. The total efficiency is therefore quite good. The design of the commutator machine is facilitated by the low frequency. This system may be used to advantage for regulating the use of induction motors for ventilators, blowers, pumps, rolling mills, etc. A special application is the use of the cascade system in connection with a flywheel for equalizing the load in three-phase networks containing winding motors, rolling-mill motors or traction motors with a quickly fluctuating power consumption. The motor is connected at any point in parallel with the network and equalizes the load fluctuations by means of the flywheel. The regulation of the set is accomplished by special relays. The largest commutator machine at present under construction by Brown, Boveri & Company has a rating of 900 kva.—*Elek. Zeit.*, Sept. 14.

Lamps and Lighting.

Gas and Electric Lighting.—K. Schlesinger.—The conclusion of his article on the comparative hygienic effects of gas and electric lamps. In the first part he had shown that gas lamps increase the temperature and the humidity, which are both serious hygienic disadvantages, while the electric lamps overcome the small disadvantage of a slight increase of temperature by the advantage of a reduction of humidity. In the present instalment he shows that gas lamps produce obnoxious gaseous products in considerable quantities. Moreover, the ventilating effect of a gas flame, which has been emphasized by gas engineers as a great advantage, is so small that it cannot even remove any considerable fraction of the combustion productions of the flame itself. It certainly cannot improve the air, as has been claimed by gas engineers. Finally, gas of the quality now used does have less odor than formerly and therefore there is a greater danger of poisoning. The author also believes that the use of gas may have a detrimental effect on the nervous system.—*Elek. Zeit.*, Sept. 28.

Automatic Transformer Switch for Low-Voltage Metallic-Filament Lamps.—An illustrated description of an exhibit at the present Olympia Electrical Exhibition in London. It is an automatic transformer switch for use in connection with 25-volt or 50-volt installations connected

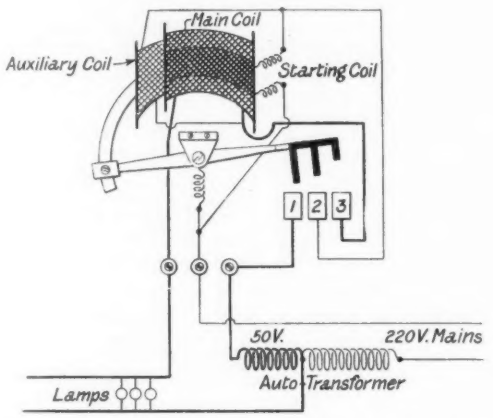


Fig. 1—Diagram of Automatic Transformer Switch.

to 200-220-volt mains through auto-transformers. When no lamps are on, the main circuit of the auto-transformer is open at the mercury cup (see Fig. 1). As soon as one lamp is switched on a circuit is established through the coil marked starting coil and the "auxiliary" coil and "main" coil in series and the core is sucked into the coil, making contacts 1 and 2. This connects the auto-transformer to the mains at contact 1 and also short-circuits the starting coil at contacts 1 and 2. When a few more lamps are in circuit, bringing the current up to 2.2 amp, the core has been sucked in further and contact 3 is made, short-circuiting the "auxiliary" coil and leaving only the main or retaining coil in circuit. The object of successively short-circuiting the first two coils is to diminish the voltage drop. When the lamps are all switched off the arm falls by gravity and the auto-transformer is out of circuit.—Supplement to Lond. *Elec. Eng'ing*, Oct. 5.

Leading-In Wires.—A note on a recent British patent (1210, Sept. 28, 1911) of Mr. C. H. Weber. A process for connecting filaments to the leading-in wires consists in

soldering or welding with the aid of sulphide metal compounds, such as sulphide of tungsten or molybdenum. These can be decomposed at a very low temperature and the fusing operation can take place in the open air instead of in hydrogen.—Lond. *Elec. Eng'ing,* Oct. 5.

Two-Phase Incandescent Lamp.—A note on a recent British patent (17,480, Sept. 28, 1911) of Mr. W. G. Houskeeper. In preparing filaments for incandescent lamps the continual heating and cooling that takes place when single-phase currents are used causes the material to break. According to this invention use is made of two-phase currents, so that the current of one phase traverses one-half of the filament while the current from the second phase simultaneously passes through the second half. Since the currents differ 90 deg. in time-phase, one portion of the filament is hottest when the other is coolest, so that expansion and contraction of the parts take place together and the length of the filament remains constant. An auto-transformer and lamps are provided in each phase-circuit to regulate the current.—Lond. *Elec. Eng'ing,* Oct. 5.

Phenomena in Mercury Tubes.—J. H. VINCENT.—A long illustrated account of an extended investigation of the following luminous effects in mercury tubes: (1) Persistent illumination in which a mercury arc increases and decreases in length rhythmically. (2) Periodic illumination in which the arc is intermittent. (3) Persistent illumination in which the arc is of constant length. These are called the necklace, fan and ribbon effects respectively to indicate the appearance observed on viewing the arc in a revolving mirror, the axis of rotation of which is parallel to the tube in which the arc occurs. The author also deals with the emission of a faint bluish-green light from a space containing liquid mercury and its vapor and adds some observations on the phosphorescence of fused quartz. —*Philos. Mag.,* October.

Generation, Transmission and Distribution.

Fluctuation of Load of Central Stations.—C. SCHMIDT. —A mathematical paper on load fluctuations due to the different requirements of different classes of consumers. The author shows how far the different classes of consumers take the energy at more or less different hours and for more or less long periods. He then gives some calculations based on the laws of probability for the fluctuations of load caused in single branches and districts of a distribution network, for the voltage fluctuations thereby produced, and for the resulting excess of cost of energy distribution.—*Elek. Zeit.,* Sept. 14.

Electric Lighting in Strassburg.—A. LOEWE.—An article describing the excellent results which have been obtained in Strassburg, Germany, in a systematic campaign for extending central-station service. Upon the advent of the tungsten lamp the 15-cp unit was adopted to supersede the smaller carbon-filament units. The central station pays the cost of wiring and installing the first four lamps for each consumer, the wiring being done by local contractors. The first lamps are installed free of charge to the consumer if at least four consumers in the same house make application to the station. For the instalment of the second, third and fourth lamps a monthly charge of 6 cents per lamp is made for the first six years. The expense of installing more than four lamps is not paid by the central station. For rent of the wiring switches, fuses and meter board 6 cents is charged per month. Each consumer must sign a contract that he will use for six years electrical energy to the amount of at least $4.50 per year. Electric lighting has become very popular with this system and has been introduced even into the smallest houses of workingmen. In January, 1910, the receipts of the central station for lighting were $1,380, and in January, 1911, $5,030—that is, almost four times as much, while the receipts per consumer were 94.5 cents in January, 1910, and 99.2 cents in January, 1911. That even very small residences are now electrically lighted is shown by reference to the suburb of Stockfeld, where there are some 500 residences for which the monthly rent is not over $4.50 to $6.25. All of them are now electrically lighted, 1400 lamps being installed in this suburb. The energy is either metered and paid for at the rate of 10 cents per kw-hour, or prepayment meters are employed. The city of Strassburg has 40,000 households and almost 2200 meters are now installed. The results obtained show that electric light can successfully compete with gas and even kerosene-oil lighting. The other problem of central stations, namely, to extend the hours of use of electric energy, is far more difficult to solve. The capacity of the Strassburg station is 18,000 kw, but in spite of large motor connections the load during the day hours is only 4000 kw and during the night is only 1200 kw. It is thus necessary to encourage the use of electricity for other purposes than lighting, and especially for cooking. The author recommends a flat rate for all consumption up to a certain number of watts. If more than this number of watts is consumed the excess is metered and paid for at 10 cents per kw-hour.—*Elek. Zeit.,* Oct. 5.

Energy for Traction from Combined Stations.—The joint committee of representatives of the (British) Municipal Electrical Association and the (British) Municipal Tramways Association has adopted a set of principles to serve as a basis for the charge for electrical energy supplied for traction purposes from combined stations. Some of the more important ones are as follows: That the charge should be based upon the actual cost of production. That in order to ascertain the actual cost of production it is necessary that the "standing costs" and the "running costs" should be properly separated. That the tramways department's proportion of the standing costs should be the ratio which the maximum demand for traction purposes at the generating station bears to the total maximum demand on the generating station. That the tramways department's proportion of the running costs should be the ratio which the total number of units delivered to feeders at the station for traction purposes bears to the total number of units delivered to the feeders at the station for all purposes. That the traction maximum demand should be taken to be the mean of the figures representing (1) the maximum traction demand at any time of the year, and (2) the average of the daily maximum traction demand (Sundays excepted) taken over a period of a month coincident with the maximum demand on the station. The method of ascertaining the traction maximum shall be taken as the maximum observed load, deducting therefrom 20 per cent. —Lond. *Electrician,* Oct. 6.

Installations, Systems and Appliances.

Melbourne.—An abstract of last year's financial report of the municipal central station of Melbourne. The number of kw-hours sold for private lighting increased by 149,028, in spite of the growing use of metallic-filament lamps, while the power sales for motor service increased by no less than 537,969 kw-hours. The total output for all purposes was 8,920,489 kw-hours, as follows: Private lighting, 3,803,091 kw-hours; heating and motor service, 3,098,960 kw-hours; street lighting, 1,736,695 kw-hours; municipal buildings, 281,743 kw-hours. The electricity department provided free lamp renewals to consumers using carbon lamps. The growing use of metallic-filament lamps, however, has led the committee to consider how far consumers using these lamps can be given an equivalent benefit. The main difficulty arises in the case of consumers who have installed both types of lamps. The number of factories operated by steam decreased from 1316 in 1903 to 1192 in 1909, while the number of factories operated by electric motors increased from 195 in 1903 to 802 in 1909. The total cost of energy generation, including capital charges, was 5.42 cents per kw-hour sold in 1910 (against 5.56 in 1909).—Lond. *Electrician,* Oct. 6.

Small Central Stations.—H. Beckman.—An illustrated article on central stations in small towns or villages. He shows that such small stations may have a distinct right of existence. A small station which is operated in connection with an existing water mill is described and shown to be financially successful.—*Elek. Zeit.*, Sept. 21.

Wires, Wiring and Conduits.

Mechanical Properties of Hard-Drawn Copper.—D. R. Pye.—A note on a recent paper read before the (British) Institute of Metals, in which the author deplored the lack of any satisfactory definition of standard hard-drawn copper. Although the (British) Post Office specification was highly satisfactory for the sizes of wire used in telephone and telegraph construction, it was quite unsuitable for larger sizes. The various definitions adopted from time to time were reviewed, and it was suggested that the one at present adopted by the engineering standards committee, namely, "the term hard-drawn copper wire shall apply to wire which does not elongate more than 4 per cent on a gage length of 10 in. when broken by tension," though not contradictory of the properties of hard-drawn copper, was unsatisfactory, since a specification should preferably fix a minimum elongation as a safeguard against the wire becoming brittle. An important point is that tensile strength per square inch and elongation at fracture both depend on the diameter of the wire. Experiments were described confirming a suggestion made by A. P. Trotter that the tensile strength per square inch diminishes with increase in diameter according to a linear law. It was also shown that the elongation at fracture for similarly manufactured wires depends very much on the diameter, being considerably greater for larger sizes of wire. In view of these experiments it was suggested that a satisfactory definition of hard-drawn copper wire should fix a minimum tensile strength per square inch given by the formula $T = 30 - 20D$, and a minimum elongation per cent at fracture given by the formula $e = 5D$, where D is the diameter in inches. The specification would hold good for sizes up to 0.5 in. diameter.—Lond. *Electrician*, Oct. 6.

Machine for Calculating Electric Networks.—J. Nowak.—The author emphasizes the difficulties of making network calculations by analytic or by graphical methods on account of the many equations and large number of unknown values. For this reason such methods are unsuitable for continuously controlling the load of a network, although such a control is very advisable. The author has designed a machine which carries out these calculations purely mechanically. Its construction and action are described and its use is discussed.—*Elek. Zeit.*, Sept. 28 and Oct. 5.

Units, Measurements and Instruments.

Measurement of Dielectric Losses with a Bridge.—K. W. Wagner.—The dielectric losses cause the current in a condenser to lead the emf not by 90 deg. but by 90 deg. — α. A condenser is therefore equivalent to a pure capacity C_1 in series with a non-inductive resistance R_1. One of the most exact methods for measuring R_1 and C_1 is by means of bridge arrangement *A, B, C, D* (Fig. 2), in which W_1, W_2 and R_2 are non-inductive ohmic resistances and C_2 is an air condenser in which the dielectric loss is negligibly small. Under these conditions the ratio of W_1 to W_2 equals that of C_2 to C_1 and equals that of R_1 to R_2 if the current through the telephone T is zero, S being a source of current. If this method is used, however, certain difficulties are experienced and the accuracy is especially affected by the capacity and leakage of the different parts of the bridge to earth. This trouble can be overcome by bringing the branch $C\ D$ to the potential of earth. As shown in the illustration, the auxiliary branch $A_1\ E\ B_1$ is connected in parallel with the bridge, point E being earthed. The bridge is first approximately adjusted. After that W_3, R_3 and C_3 are so adjusted that the current in a telephone between E and D or between E and C becomes a minimum. The telephone is then removed and the bridge is adjusted. The rationale of this arrangement is discussed and a numerical example is added.—*Elek. Zeit.*, Oct. 5.

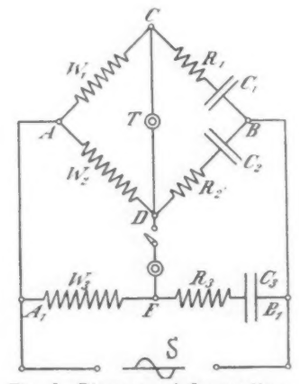


Fig. 2—Diagram of Connections.

Telegraphy, Telephony and Signals.

The Balloon as a Wireless Telegraph Receiving Station.—P. Ludewig.—An account of the arrangement of the antenna for receiving wireless telegraph messages on balloons. When the balloon was half filled a wire was wound round the equator of the gas bag, being interwoven through the protecting cordage, and the end of the wire was placed in the basket. The wire formed the upper half of the antenna. To form the lower half a heavy wire was dropped from the basket after the balloon had risen. Fig. 3 shows the completed arrangement. The object of the tests was to discover with how simple means picking up of messages was possible. A Schloemilch cell was used as receiver, and this was connected direct to the antenna, as shown in Fig. 4, in order that the room taken up should be as little as possible. With this arrangement accurate tuning was, of course, impossible. Approximation to the wave-length of 500 m at the sending station was obtained when the wire from the basket was 125 m long or equal to one-fourth wave-length. The choice of the simple means for receiving also solved the problem as to whether damped or undamped waves should be used for sending, the small tuning capacity of the receiving station making the use of the first-named a necessity. Some of the results obtained in the tests, although not all, were satisfactory.—Lond. *Electrician*, Oct. 6.

Figs. 3 and 4—Balloon as a Wireless Receiving Station.

Electrochemistry and Batteries.

Cost of Alkali Chloride Electrolysis.—V. Engelhardt.—The author discusses the direct production of hypochlorid

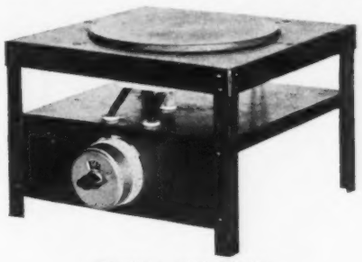
solutions and the production of chlorine and caustic alkali separately by electrolysis of common salt at the consumers' works and compares the cost with the cost of producing the bleaching solution from bleaching powder bought in the market. Among the processes for separating producing caustic soda and chlorine, for which figures of cost are given, are the Billiter diaphragm cell and the mercury-cathode cell. Under the conditions at present existing in Germany the author reaches the following conclusions: According to the different processes, the maximum energy cost for which alkali chloride electrolysis is profitable varies between 0.75 cent and 1.125 cents per kw-hour. In the smaller installations of the textile industry the direct electrolytic production of hypochlorite (electric bleaching) is in general financially profitable only when there is a certain saving of active chlorine. But even if the cost of producing the bleaching liquor by electrolysis is somewhat higher than with the use of bleaching powder, the other technical advantages of electrolytic hypochlorite (less wear and tear of the fibers, smaller acid consumption, etc.) still justify the use of the electrolytic hypochlorite process. In paper and pulp mills, as well as in larger installations of the textile (especially linen) industry, it will in general be more profitable not to produce directly a hypochlorite solution, but to produce separately chlorine and caustic soda and make use of or sell the caustic soda. With satisfactory prices for energy the erection of such plants is justified *per se*, as against the purchase of chloride of lime. In the large-scale chemical industry and under average conditions the diaphragm processes are superior to the mercury-cathode processes with respect to both first cost and cost of operation. In the case of erection of a new plant the use of a mercury-cathode cell will be justified only when there is a sure market for the caustic soda free from sodium chloride at a higher selling price and if very cheap energy is available.—*Met. and Chem. Eng'ing*, October.

Vanadium.—W. F. Bleecker.—The conclusion of his long serial on the chemistry and metallurgy of vanadium. The author deals with the metallurgy of vanadium ores, the nature and composition of mill solutions, the preparation of vanadate of iron, electrolytic methods of preciptation, production of vanadic acid and the author's electrolytic method for vanadic acid. The presence of titanium in vanadium ores and products is briefly discussed and notes are given on the use of vanadium for steel making.—*Met. and Chem. Eng'ing*, October.

New Apparatus and Appliances

ELECTRIC HOT PLATE.

An 8-in. disk stove now being placed on the market by the General Electric Company is designed for use in readily increasing the capacity of the kitchen equipment of hotels and restaurants, and also for use in carpenter shops, binderies and other manufacturing establishments



Electric Hot Plate.

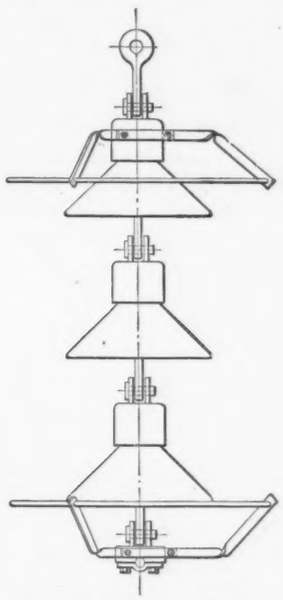
requiring a rapid-heating hot plate free from the inherent dangers of gas plates. The stove is provided with a heating element of "calorite," and a three-heat indicating switch serves to give 375 watts, 750 watts and 1500 watts heat dissipation on 95-128 volts, or 300 watts, 600 watts and 1200 watts on 200-250 volts.

PROTECTING RINGS FOR TRANSMISSION-LINE INSULATORS.

The Locke Insulator Manufacturing Company, Victor, N. Y., is now manufacturing and marketing the Nicholson arcing rings for transmission lines which were first used on the lines of the Niagara, Lockport & Ontario Power Company, and formed the subject of a paper read by the inventor at the Charlotte, N. C., meeting of the American Institute of Electrical Engineers, March, 1910, as mentioned in our issue dated April 7, 1910.

A stroke of lightning within, say, a quarter of a mile or less of a transmission line frequently induces surges which cause an insulator to flash over, and the power arc that follows, being concentrated under the shells of the insulator in grounding to the pin, mechanically ruptures the insulator owing to the concentrated heat of the arc; and after the shells are thus cracked the current follows in full force, creating a destructive effect.

It was upon this analysis that the arcing ring was based. The device allows the flashover to take place between an upper ring, which is connected to the line cable, and a lower



Nicholson Arcing Ring.

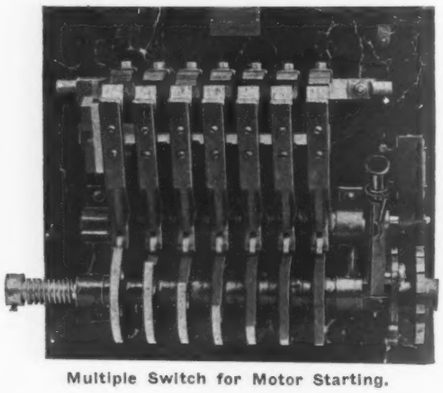
ring, which is grounded to the cross-arm or pin, and is so removed from the insulator as to prevent the heating above referred to. After the circuit-breakers have gone out it has been demonstrated that the line thus protected with the Nicholson rings can be cut in again, the insulators being intact. This result is, of course, gratifying as compared with the old condition of a line grounded through ruptured insulators, in which case it was necessary to send out line-

men to make repairs before operation could be resumed. It will be apparent that this security is especially valuable in the case where an important motor load is being carried on a single circuit and cannot be transferred to a duplicate line, or in the case of isolated, inaccessible portions of a line.

Very many ideas have been held regarding the service to be performed by high-voltage insulators. Some engineers expect them to remain immune from damage by line discharges, depending for line protection upon lightning arresters and ground wires; others have advocated making the insulator rugged enough to remain intact following a flashover, such flashover, moreover, preventing destruction in the power house. The Nicholson ring is, however, based on the growing idea that insulators are special pieces of apparatus that are in a sense frail and should be protected against destructive discharges as in the case of any other piece of apparatus.

MULTIPLE SWITCH FOR MOTOR STARTING.

A multiple-switch motor starter which can be used also as a speed regulator of large size is shown in the illustration. The device, made by the Independent Electric Manufacturing Company, of Milwaukee, is designed for direct-current operation and is provided with underload release. It is intended for use in starting large, heavy-duty motors. The interesting characteristic is that the operator can start this controller without leaving one position or without the trouble of throwing in one contact with one hand while



Multiple Switch for Motor Starting.

holding another contact handle with the other hand. A master lever is provided with a pawl which engages a ratchet by a forward movement, throwing in a contact lever by means of a cam. By a reverse movement of the master lever the pawl is made to engage the next ratchet and a second forward movement will throw in another contact. The construction is such that the operator cannot leave the contact levers on any of the intermediate brushes. As soon as the master lever is released a secondary lever engages the ratchet and throws the contact levers to the "off" position.

DIFFUSING GLASSWARE FOR INCANDESCENT LAMPS.

The "Luceo" reflectors made by the Jefferson Glass Company, Follansbee, W. Va., are designed to be used in connection with brilliant light sources so as to obtain the maximum diffusion with a minimum of glare. The glassware is characterized by a peculiar limpid translucency, closely resembling that of white onyx, while the surface as seen by reflected light, possesses the waxy gloss characteristic of the same natural product. In addition the reflectors possess two qualifications which add to their usefulness. They do not readily collect dust or soil, and when

Fig. 1—Bowl Reflector.

cleaning is necessary the operation can be performed with a minimum amount of trouble and expense. The manufacturer claims that, by reason of its peculiar surface and composition, it is not necessary to have the light sources accurately placed or focused, and that the distribution of light is all that can be desired for all purposes of illumination. The distribution from a 60-watt frosted tungsten electric lamp, with a bowl reflector of the type shown, is illustrated in Fig. 2. The glassware is said not to affect the color value of the light, the reflector when the lamp is lighted having the exact color of the light source within,

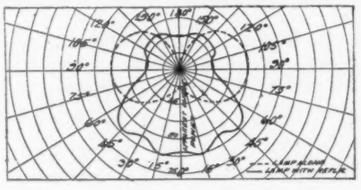


Fig. 2—Distribution Curve.

without streaks and variations. Two types of reflectors are at present made, giving wide and medium angles of distribution, in addition to hemispheres, which may be used singly as ceiling bowls or joined together to form spheres.

PORTABLE AND STATIONARY DIRECT-CURRENT METERS.

New voltmeters and ammeters are being put upon the market by the American Ever Ready Company, New York City. Although the d'Arsonval principle is followed, the construction is entirely new. Instead of a horse-shoe type a circular magnet is used which eliminates waste space in the case and permits a larger magnet to be used than would be possible with the horse-shoe type.

The dead beat is secured in a new way. The practice of reducing the air gap between the magnet ends and the armature to an extremely fine point, has been abandoned. In that type of construction the lines of force passing through the aluminum armature secured the desired dead-beat effect, but the closeness of the adjustment was productive of trouble. In the Eveready meters a metal bar bridges the opening between the magnet ends. Attached to the pivot staff on which the armature swings is an aluminum disk which rotates between the bridge and the magnet. The lines of force in their effort to reach the bridge encounter the aluminum disk and produce the dead-beat effect. This shunting of the lines of force through the bridge in no way affects the efficiency of the meter since the magnets are larger than would be necessary if there were no magnetic shunt. The efficiency of the magnets is great and permits a strong spring to be used.

Where extremely close relation of parts is necessary,

the manufacture of small meters is a difficult and costly proposition, whereas by the method of construction followed in the Eveready meters small meters are as easy to build and are as accurate as the larger types.

Another step toward simplification is the method of constructing the armature. Instead of attaching separate pivots to each end of the armature frame, the pivot staff is one piece from one bearing jewel to the other. This avoids the trouble that is inevitable where the pivot staff is made up in three pieces. It is claimed that this reduces the chance of broken jewels to a minimum and that with this construction there is little chance of the expansion or contraction from heat and cold affecting the action of the instrument.

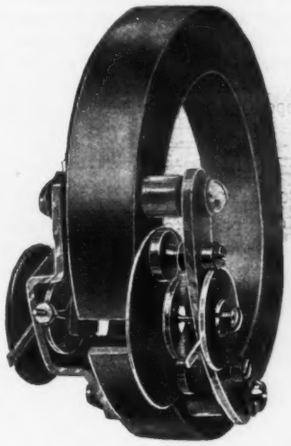


Fig. 1—Circular Magnet.

Figs. 2 and 3—Ammeter and Voltmeter.

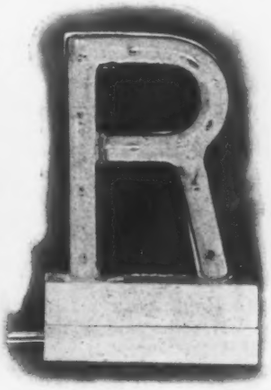


Fig. 1—Electric Alphabet Lamp.

ELECTRIC "ALPHA-BET" LAMPS.

An unusually interesting and pleasing novelty in the way of electric-sign lighting has made its appearance in Chicago. This sign lighting is designed for interior installation, as in show windows or in various sections of department stores, and although the signs are not large they are bright, dainty and attractive. The method employed is to use the letters of the alphabet, each consisting of an individual incandescent lamp containing a number of miniature carbon filaments. These alphabet lamps are 3½ in. high and are made of clear glass tubing backed by a white cement-like substance which serves as the base of the tiny filaments and also contains the wires connecting the filaments in series. This backing also acts as an effective reflector. Fig. 1 shows the alphabet lamp R and Fig. 2 shows nine of the letters assembled to make a word. The pictures do not do justice to the attractiveness of this form of sign lighting, however. The number of miniature filaments used in each lamp varies from twelve in the case of M and W to five for I. Each lamp is made in the form of a continuous tube bent in the form desired and is an actual lamp, the filaments burning in a vacuum, of course.

As shown in Fig. 1, each lamp is mounted on an individual porcelain base. This base is provided on one side with projecting clips and on the other with receptacles for the corresponding clips of the next letter. The letters are arranged in a metal trough, as shown in Fig. 2, and they are operated from any convenient source of 110-volt energy, by means of a terminal block put in before the first letter. A blank porcelain base or "space" is put in the trough where necessary to separate one word from another. As stated, the filaments in the lamps themselves are connected in series, but the two metal strips running through the bases of the lamps are like little busbars to which each end of the individual series circuit of each lamp is connected, so that the system of wiring of the sign as a whole is series multiple.

The filaments in each alphabet lamp, whether five in the case of the letter I or twelve in the case of the letter W, or any intermediate number, are designed so that each lamp, irrespective of the number of filaments, takes 11 watts. It is said that each lamp gives about 2½ cp, and that, on an average, each of the tiny filaments gives perhaps one-third of 1 cp. All the letters of the alphabet are provided, of course, and they can be arranged to make any sign or combination desired. It is said that one Chicago department store, with a supply of forty letters, is enabled to make twenty-seven different signs. The lamps, although small, are made strongly and can be arranged by an office boy to spell out a sign.

The consumption of energy is, of course, slight. For instance, the sign "This Way for Waists" contains sixteen letters which would mean a consumption of 176 watts, so that the sign could burn over five hours for 10 cents, assuming the price of energy to be 10 cents a kw-hour. The stand or trough for the lamps can be made in oxidized, nickel, brass or other finish. A flasher can be connected in the circuit to produce changing effects if desired. No wiring is visible about the sign. While the lamps made of clear glass tubing backed by the white reflecting substance are effective and pleasing, there is no reason why colored glass tubing should not be used if desired.

Mr. A. W. Gast is the inventor of this ingenious system of interior sign lighting. Mr. Gast has had long experience in the development of miniature incandescent lamps, having been connected for years with the miniature lamp department of the Western Electric Company in Chicago, where he brought out some notable improvements in miniature lamp manufacture, particularly as adapted for telephone switchboard signals. Mr. Gast is now treasurer and manager of the Chicago Miniature Lamp Works, 13-17 North Jefferson Street, Chicago, and this company is putting the new Alpha-Bet lamps, as they are called, on the market. It may be of interest to add that the lamps, which are made under patented processes, are sold outright to consumers, the price being fixed at $3 a lamp.

Fig. 2—Electric Alphabet Lamps Arranged for Sign.

Industrial and Commercial News

The Week in Trade.

PREVALENCE of low prices and necessity to replenish low stocks are the most probable causes of the present expansion in business transactions throughout the country. Advancement of the season has without doubt been responsible for some of the increase in the turnover, but the large number of small orders being placed for early delivery serves to show that confidence in the future is not fully established among the majority of business interests. The market for men's wear is improving, and demand for dry goods is showing signs of broadening. While buyers of cotton goods are waiting for readjustment of prices and are not placing orders very far ahead, the outlook in this direction is encouraging. Sales of wool in the past few weeks have been on a larger scale than in several months, and steady progress in this industry is expected. New business, induced by low prices, is being received by the steel mills in sufficient volume to insure activity for some time to come, but earnings are naturally showing a falling off as a result of price reductions. Inquiries for rails, cars and bridge equipment have decreased in volume since last report, and while many of the roads are believed to be considering new supplies there exists a rather general tendency to delay action as long as possible. Production of pig-iron is fairly heavy, and many consumers are making strong efforts to close contracts for their needs in the first quarter of 1912 at present prices. These are so low that many operators are keeping furnaces out of blast, considering that the present market leaves too small a margin of profit in view of the cost of operation. Anthracite coal is in good demand, and shipments to New England, in anticipation of the close of river navigation, are very large. As a consequence of the crop movement a substantial decrease has taken place in the number of idle cars. Business failures for the week ended Oct. 19, as reported by *Bradstreet's*, were 258, as compared with 212 for the previous week, 197 for the corresponding week in 1910, 244 in 1909, 231 in 1908 and 220 in 1907.

The Copper Market.

WITH prospects of an increase of at least 20,000,000 lb. in surplus copper stocks this month, consumers do not seem greatly concerned with the recent advance in prices. They feel that they can afford to wait further developments in the situation, and only a few have been obliged to enter the market at existing rates. These are but slightly higher than last week's quotations. Between 12.40 cents and 12.45 cents cash and about 12½ cents delivered are now asked for electrolytic, while the European price is from £57 10s to £57 12s. Most of the sales made in this country in the past few days have been at 12¼ cents to 12⅜ cents. The temporary advance in price has been caused by manipulation based upon the belief that stocks held by consumers were exceedingly low and that the time was opportune for an increase in rates. While there is a great deal of scattered buying, aggregating a fair tonnage, this is not in sufficient volume to make a permanent inroad upon the stocks held by producers, and there is no mistaking the fact that the rate of consumption does not approach the rate of output. Inasmuch as producers continue to sanction large output in the face of high costs of operation and slackening in both foreign and domestic interest, the situation is rapidly assuming a decidedly serious aspect. Demand for finished copper products has fallen off sharply, and in spite of low prices. Exports for the month, including Oct. 24, aggregate 16,686 tons. The daily call on the Metal Exchange Oct. 24 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.15	12.25	....
October	12.15	12.25	12.20
November	12.15	12.25	12.20
December	12.15	12.25	12.20
January	12.15	12.25	12.20

The London market, Oct. 24, was as follows:

	Noon. £	s	d	Closing. £	s	d
Standard copper, spot	55	15	0	55	13	9
Standard copper, futures	56	10	0	56	10	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.35			11.57½		
London, spot	£57	10	0	£53	7	6
London, futures	58	2	6	54	0	0
Best selected	61	10	0	57	5	0

Industrial and Commercial Notes.

Eastern Michigan Edison Company to Build Plant at Ann Arbor.—Plans have been completed by the Eastern Michigan Edison Company of Detroit, Mich., for the erection of a generating plant at Ann Arbor, Mich., which will cost $250,000 including real estate. The new plant will have a capacity of 800 hp and will be located near the present waterworks pumping station on the Huron River, where a dam will be built, forming a basin of some 300 acres. The new station will be known as the Barton plant, and the energy generated there will be distributed to customers of the Washtenaw Light & Power Company of Detroit, in Ann Arbor, Ypsilanti, Saline, Wayne and Dearborn. When the plant is completed, the plant of the Eastern Michigan Edison Company at Argo, Mich., will be used as a substation and the present dam at this place will be removed. In connection with its new plant, the company has planned to beautify the land along the river, and has retained a Boston landscape gardener for designing the improvements. Contracts for the erection of the plant will be let within thirty days.

$15,000,000 Hydroelectric Project in New Hampshire.—The Central New Hampshire Power Company has been incorporated in Maine, with a capital of $10,000,000 common stock and $5,000,000 preferred stock to develop extensive water-power sites in Sullivan, Merimack, Hillsboro and Grafton Counties, N. H. The officers of the company are: President, Robert C. Bacon, of Brattleboro, Vt.; treasurer, Clarence E. Eaton, of Portland, Maine, and clerk, James E. Manter, of Portland, Maine. It is stated that the new company has secured options on property which will give it control of water rights on the Black Water, Sugar, Mascoma, Smith, Warner and Contoocook Rivers. Reservoirs will be formed by the erection of dams at various points along these rivers, and it is said that the combined potentiality of these streams will be nearly 100,000 guaranteed ten-hour horse-power and about 20,000 secondary horse-power. The energy will be utilized at various manufacturing centers in New Hampshire and Massachusetts.

Electricity on Catskill Aqueduct.—H. S. Kerbaugh, Inc., who are building the dam at Kensico Lake, Westchester County, New York, where a large storage reservoir is to be constructed as a part of the Catskill Aqueduct project for the water supply of New York City, have entered into a contract with the Yonkers Electric Light & Power Company for a supply of energy aggregating 4000 kw to be used on the construction work. The energy will be furnished at about 40,000 volts, the line voltage being increased to this by a step-up transformer at Yonkers, and lowered as desired by transformers at the customer's end of the line. Cable-ways, hoists, air-compressors, pumps and concrete mixers are to be driven by this energy. The dam will be 1830 ft. in length, 250 ft. high, and 227 ft. in width at the bottom and 27 ft. at the top.

Hoosier Sales Company to Make Farmers' Lighting Plants.—The Hoosier Sales Company, of Jamestown, N. Y., has been incorporated under the laws of New York State, with a capital of $150,000, to make and sell machinery and devices for generating electricity; also to manufacture motors and batteries. The directors are Frank L. Wyman, of Indianapolis, Scott H. Penfield and Benjamin S. Dean, of Jamestown, N. Y. The company will make isolated electric plants for farmers' use. These plants comprise a small gasoline engine, a dynamo, a storage battery, switchboard and the necessary accessories. The new company will be associated with the Metal Products Company, of Greenville, Pa.

Arbitration by Technical Judges.—Judge Learned Hand, of the United States District Court in the Southern District of New York, recently rendered an opinion in the case of Parke, Davis & Company vs. the Mulford Company, involving infringement of patents used in the manufacture of chemicals, in which he says: "I cannot stop without calling attention to the extraordinary condition of the law which makes it possible for a man without any knowledge of even the rudiments of chemistry to pass upon such questions as these. * * * In Germany, where the natural spirit eagerly seeks for all the assistance it can get from the whole range of human knowledge, they do quite differently. There the courts summon technical judges to whom technical questions are submitted and who can independently pass upon the issues without blindly groping among testimony wholly out of their ken. How long we shall continue to blunder along without the aid of unpartisan and authoritative scientific assistance in the administration of justice no one knows, but all fair persons not conventionalized by provincial legal habits of mind ought, I should think, to unite to effect some such advance." In making this comment upon the present condition of the law in the United States Judge Hand was merely expressing the thought underlying the plan of the New York Chamber of Commerce for the adjustment of commercial disputes by arbitrators selected from an official list. This plan provides, in a most practical way, for the disposition of technical questions arising in business by men peculiarly qualified by reason of their experience to deal with such questions. As the list covers men in all lines of business and industry, there is no longer any necessity for submitting such questions to untrained jurors, or judges unprepared for such technical questions. The plan was described in these columns Aug. 5.

Louisville Lighting Company.—Gen. George H. Harries, of the staff of H. M. Byllesby & Company, of Chicago, has been elected president of the Louisville Lighting Company, of Louisville, Ky., and of the Louisville Gas Company, which controls the former corporation. General Harries succeeds F. M. Sackett, who has been president of the companies since the retirement of Udolpho Snead several years ago. Mr. Sackett resigned to accept the position of first vice-president of the Fidelity Trust Company, a leading financial institution of Louisville. The election of General Harries indicates that the Byllesby interests have decided to purchase control of the Louisville public-service companies in spite of the fact that they have been unable to secure an option on the city's holdings, amounting to about one-third of the total stock, to which reference was made in these columns Sept. 9. The Chicago concern is in a position to purchase practically all of the remaining stock at 120 a share, though a pool which was formed by Louisville trust companies for the purpose of enabling a change of control to be effected was recently dissolved. The change in the executive head of the companies was accompanied by an unofficial announcement to the effect that the Louisville Lighting Company is considering bidding for the steam-heating franchise which is provided for in an ordinance introduced in the General Council of Louisville several weeks ago at the instance of the Kentucky Electric Company, of Louisville. This means, in the event of the passage of the ordinance and the final decision of the Louisville Lighting Company to bid, that the franchise will bring over $500, the upset price named in the pending ordinance.

Opposition to Montreal Traction Merger.—Alleging that the resolution amalgamating the Montreal Street Railway Company with the Montreal Tramways Company, to which reference was made in the previous issue, was illegal, since shareholders were not supplied with full information before voting, Senator F. L. Beique has entered a suit against the Montreal Street Railway Company asking for annulment of the resolution. Earnings of the Montreal Street Railway Company in the fiscal year ended Sept. 30 were the largest in the history of the company, and it is believed that when full returns are announced a surplus over charges and the payments to the city of about 14½ per cent on the total outstanding stock will be shown as compared with about 12 per cent in the previous year.

Annapolis Short Line Railway.—Messrs. Ford, Bacon & Davis, of New York, are now making a thorough examination of the Annapolis Short Line Railroad, with a view to ascertaining the best method of operating the property by which the business of the company can be increased and its operating expenses materially reduced. The Short Line Railroad is gradually increasing its business, but operating expenses have shown a tendency to increase, and it is now the intention of the officials of the company to ascertain whether or not the Short Line can increase its traffic and at the same time reduce its cost of operations. It has been stated more than once that the present half-hourly schedule is a pretty expensive proposition, and that the business which is now handled over the line does not warrant such frequent operations of trains between Baltimore and Annapolis. The entire situation is to be gone over carefully by the New York experts.

Public Service Company of Northern Illinois.—Announcement will be made soon of the organization of the Public Service Company of Northern Illinois, to be composed of the North Shore Electric Company, of Chicago; Economy Light & Power Company, of Joliet, and the Illinois Valley Gas & Electric Company, of Chicago. No doubt one or more additional public-service companies will be taken in the combination also. The North Shore Electric Company operates in the suburban area around Chicago, and the Economy company in the territory in and around Joliet in Will County, while the Illinois Valley company, which has its operating headquarters in Streator, serves Grundy, LaSalle and adjoining counties. Details of the financial aspects of the merger will be announced later.

Telephone Train Dispatching.—The Cincinnati, Hamilton & Dayton Railroad Company has completed plans for the installation of a telephone train-dispatching system on its main lines between Cincinnati and Toledo, Ohio, and between Hamilton, Ohio, and Indianapolis, Ind. The Western Union Telegraph Company is rebuilding its system along this road, and when the work is completed the telephone system will be installed. The Baltimore & Ohio Southwestern Railroad Company is also installing a telephone-dispatching system, and the first service, according to present advices, will be installed between Cincinnati and St. Louis.

Extensions at Lethbridge, Alberta.—The city of Lethbridge, Alberta, Canada, is advertising for bids for material required for extensions to its municipal electric plant. Boilers, steam auxiliaries, mechanical-draft apparatus, steam economizer, turbo-generator and condensing equipment, steam-driven exciter and substation equipment are needed. Tenders will be received until Nov. 24, and should be addressed to G. W. Robinson, secretary-treasurer of the city of Lethbridge. Specifications may be obtained from Arthur Reid, superintendent and engineer of the plant.

Telephone News Service Begun.—The New Jersey Telephone Herald Company, whose plan for furnishing daily news service by telephone was described in these columns Aug. 26, began its service in Newark, N. J., on Oct. 24. News was telephoned continuously during the day from a central transmitting station to subscribers' instruments in residences, department stores and restaurants. Over 500 persons listened simultaneously to reports of the championship baseball game.

Georgia Railway & Power Company.—Formal organization of the Georgia Railway & Power Company, with a capital of $27,000,000, for the purpose of acquiring hydroelectric properties in and near Atlanta, Ga., as described in these columns Sept. 23 and Oct. 7, took place this week, with Charles Magee, of Toronto, Can., as president. Approval of an issue of $30,000,000 bonds, paying 5 per cent interest and to run sixty-five years, has been asked of the Georgia Railroad Commission.

Holtzer-Cabot Electric Company Plans.—The Holtzer-Cabot Electric Company has decided to build a new plant on Needham Street, Newton Highlands, Mass., instead of rebuilding the portion of its Brookline (Mass.) plant which was destroyed by fire Oct. 6. The two buildings of the Brookline plant which were not seriously damaged will be repaired, but the main structure will not be used.

Capital of Standard Gas & Electric Company Increased.—A certificate of increase of capital from $24,000,000 to $45,000,000 has been granted by the State of Delaware to the Standard Gas & Electric Company, which has been incorporated by Chicago interests.

Aluminum Notes and Prices.—The aluminum market as of Oct. 24 is reported quiet, with ingots for remelting quoted at 20@22 cents spot No. 1 the base for large ingots. Rods and wire are held at 31 cents and sheets at 33 cents.

Financial.

The Week in Wall Street.

ANNOUNCEMENT that the United States Steel Corporation would cancel its lease of the Great Northern iron ore properties and reduce the freight rates charged to independents for transportation of ore by the Lake Superior railroads under its control was made at the close of the past week and is regarded by many financial interests as almost conclusive evidence that a federal suit will not be instituted against the company under the Sherman anti-trust law. Optimism is, therefore, more general in the Street than has been the case for the past few weeks and, while trading is not active, the business situation seems greatly strengthened. News of the government's attitude toward the plan for reorganization of the American Tobacco Company under the statute is awaited with marked interest and, in spite of the petitions filed against the plan by the attorneys-general of Virginia and North and South Carolina on the ground that the subsidiary stocks are to be distributed among holders of American Tobacco common shares, it is thought in many quarters that it will be acceptable to the government. Trading on the New York Stock Exchange Monday was dull and prices showed but little change. Reaction in cotton prices following the advances made last week was the principal feature of interest. Apathy was in decided evidence on Tuesday and only fractional changes were registered throughout the list. The bond market is not especially active, but investment demand is gradually improving. Tariff legislation is beginning to demand consideration by financial interests, and marked agitation in general business conditions from this source is probable. Large remittances of American funds continue to be made to European exchanges at very satisfactory rates, indicating the dull condition of the domestic market. Rates in the local money market Oct. 24 were 2¼@2½ per cent; ninety days, 3½@3¾ per cent. The quotations in the tables are those at the close Oct. 24.

NEW YORK.

	Oct. 17.	Oct. 24.	Shares Sold.		Oct. 17.	Oct. 24.	Shares Sold.
All. Ch.....	2½	3	7,800	Int. Met., pf.	44½	44½	2,300
All. Ch. pf...	10	11¼*	3,800	Mackay Cos..	85*	85*	———
Amal. Cop....	51⅞	53½	86,050	Mackay C.,pf.	72½	73*	100
Am. D. T....	33⅛*	33⅛*	———	Man. Elev....	134½*	135*	———
Am. Loco....	35	34	1,900	Met. St. Ry..	15*	15*	———
Am. Loco. pf.	104*	102	550	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	78*	78*	———	Steel com....	59¾	59¾	997,700
Am. T. & T..	135⅜	134⅜	6,725	Steel, pfd....	109⅜	109⅜	8,760
B. R. T.....	75	74⅝	3,840	W. U. T....	78⅛	78⅛	6,300
Gen. Elec....	150¾	150⅜	4,900	West'h, com..	65½	64	3,900
Int. Met.....	14½	14¾	2,000	West'h, pfd..	115*	115*	100

PHILADELPHIA.

	Oct. 17.	Oct. 24.		Oct. 17.	Oct. 24.
Am. Rys.....	43½*	43½	Phila. R T.....	23¼	23
El. Co. of A.....	11¾	11⅞	Phila. Elec.....	16¼	16½
Elec. St. Bt'y.....	52⅜*	53¼	Phila. Trac.....	83½	83⅞
Elec. St. Bt'y, pf...	30*	30*	Union Trac.....	51⅛	51¼

CHICAGO.

	Oct. 17.	Oct. 24.		Oct. 17.	Oct. 24.
Chi. City Ry.....186*		186*	Com. Edison.....128⅜		128⅝
Chi. Elev. Rys.....	27	28⅞*	Chi. Subway.....	1½	1¼
Chi. Elev. Rys., pf..	90*	93	Chi. Telephone.....119½*		119½*
Chi. Rs., Ser. 1.....	92*	96½	Nat'l Car.....101*		104*
Chi. Rs., Ser. 2.....	27*	32¾	Nat'l Car, pf.....118½		118½

BOSTON.

	Oct. 17.	Oct. 24.		Oct. 17.	Oct. 24.
Am. T. & T.....135⅜		135	Mex. Tel.....	4*	4*
Cum. Tel.....150½		150½*	Mex. Tel., pf.....	6*	6*
Edison 284		287	N. E. Tel.....146		146*
Gen. Elec.....150¾		150¾*	W. T. & T.....	19½	26¾
Mass. E. Ry.....	19¾	22¼	W. T. & T., pf.....	95⅛*	105⅜
Mass. E. Ry., pf....	93	95			

*Last price quoted.
Shares sold for the week Oct. 16 to Oct. 21.

Financial Notes.

American Telephone & Telegraph Company Grouping Subsidiaries.—In keeping with its plan for bringing the numerous units composing the Bell Telephone system under one operating head or control, the American Telephone & Telegraph Company has made an offer to the minority stockholders of the Bell Telephone Company of Missouri to exchange their holdings for American Telephone & Telegraph stock in the ratio of six shares of the Missouri company for seven shares of American Telephone & Telegraph stock. The company operates in St. Louis and the adjacent country, and has $8,788,000 stock outstanding, of which the American Telephone & Telegraph Company already owns $5,831,800. A similar offer has been made to the minority stockholders of the Missouri & Kansas Telephone Company, which operates throughout the State of Kansas and in that part of Missouri not served by the Bell Telephone Company of Missouri. The ratio of exchange in this case is three shares of American Telephone & Telegraph stock for seven of those now held. Of the $13,627,700 stock of this company outstanding, $11,944,200 is already owned by the American Telephone & Telegraph Company. The company has not paid dividends since 1906. The American Telephone & Telegraph Company has offered to give three shares of its stock and $20 in cash for four shares of Western Telephone & Telegraph Company's preferred stock, and one share of American Telephone & Telegraph stock for five shares of Western Telephone common stock. The Western Telephone & Telegraph Company is a holding company which the American controls through ownership of $12,187,600 of the $16,000,000 preferred stock and $9,443,000 of the $16,000,000 common stock. The Western Telephone & Telegraph Company owns 77 per cent of the stock of the Cleveland Telephone Company, 82 per cent of the stock of the Wisconsin Telephone Company, 82 per cent of the stock of the Northwestern Telephone Exchange and 84 per cent of the stock of the Southwestern Telegraph & Telephone Company.

Cities Service Stock Offered.—Preferred stock of the Cities Service Company, which was incorporated under the laws of Delaware on Sept. 2, 1910, as a holding company for the gas and electric properties operated in Denver, Col., Spokane, Wash., and Joplin, Mo., by the Doherty Operating Company, is offered for investment. The authorized capitalization of the company consists of $30,000,000 6 per cent cumulative preferred stock, of which $8,661,240 is outstanding, and $20,000,000 common stock, of which $4,887,620 is outstanding. Monthly dividends at 6 per cent per annum on the preferred stock and of 3 per cent on the common stock have been paid continuously since organization. The report of the company for the year ended Sept. 30 gave the following: Earnings from subsidiary companies, $855,510; miscellaneous earnings, $40,715; total gross earnings, $896,225; expenses, $27,649; net earnings, $868,576; dividends on preferred stock, $502,988; dividends on common stock, $143,659; total dividends, $646,647; surplus, $221,929. The company has also declared the usual monthly dividend of one-half of 1 per cent on its preferred stock, and one-quarter of 1 per cent on its common stock, both payable Nov. 1 on stock of record Oct. 20.

Mountain States Telephone & Telegraph Company Plans Extensive Improvements.—In the first report issued since the merging of the Colorado Telephone Company, the Rocky Mountain Bell Telephone Company and the Tri-State Telephone & Telegraph into the Mountain States Telephone & Telegraph Company last July, as mentioned in these columns at that time, E. B. Field, president of the Mountain States company, says that $2,000,000 will be spent by the company in 1912 for improvements and expansion of the operating department. The value of the exchange plant as given in the report is $14,423,576 and in addition to this are real estate valued at $1,871,814 and a toll plant valued at $5,727,431. Construction now in progress is valued at $727,400 and stocks and bonds at $786,265. Earnings during the month of August, the first full month of operation under the consolidated system, were $513,000, of which $473,000 was received through exchange service.

Pacific Gas & Electric Company Votes Large Extension.—Stockholders of the Pacific Gas & Electric Company at the special meeting held Oct. 23, as scheduled in these columns Sept. 2, voted to create a new mortgage securing an increase of the bonded indebtedness of the company to $150,000,000, and also voted for a parallel increase in the capitalization, all in common stock, in accordance with the California statute which prohibits a company from having outstanding indebtedness in excess of its subscribed capital stock. As stated in these columns Sept. 2, about $60,000,000 of the bonds will be used for refunding the company's present issues, and the balance will be reserved for development work in the next ten years.

Helena Light & Railway Bonds.—A New York bond house is offering first mortgage, 5 per cent sinking fund gold bonds of the Helena Light & Railway Company, which owns and operates the entire street railway, electric lighting and gas business in Helena, Mont. The capitalization of the company is as follows: Common stock, authorized and issued, $900,000, and in hands of trustee for benefit of company, $339,000; preferred stock, authorized and issued, $600,000, and in hands of trustee for benefit of the company, $226,000; first mortgage 5 per cent bonds, authorized, $1,500,000; issued, $1,000,000; retired, $45,000. The bonds offered are coupon bonds in denomination of $1000, are dated September 1, 1905, and are due September 1, 1925. They are secured by a first and only mortgage on the entire property, plant and franchises of the company, and additionally secured by an operating sinking fund of 1½ per cent annually of outstanding bonds until June, 1917, after which date the rate will be 2½ per cent. The railway system consists of 18.5 miles of standard track covering the principal streets and sections of the city, and extending to Fort Harrison and the town of East Helena. The electric system for both lighting and power service covers the business and principal residential sections, and new business can be taken without any large extensions. All current for lighting, power and railway service is obtained from the hydroelectric plants of the United Missouri River Company under an advantageous contract which expires Jan 1, 1922. The current is distributed through a modern stone substation located near the business centre of the city. The gas system consists of a combined coal and water gas plant. Gross earnings of the company in the year ended December 31, 1910, were $309,741; operating expenses and taxes were $192,799, and net earnings from operation were $116,942. Interest on bonds was $43,000, leaving a surplus over fixed charges of $73,942. Sinking fund requirements amounted to $13,568, and the surplus for the year was $60,373. Dividend on preferred stock was $18,700, and the final net profit was $41,673. The company is under the management of J. G. White & Company, Inc., of New York, Montreal and London.

Reorganization of Hudson River Power Companies.—The physical direction of the eight Hudson River power companies which were sold to representatives of the bondholders' committee at a foreclosure sale at Ballston Spa, N. Y., Aug. 29, as mentioned in the issue of Sept. 2, has been taken over by the Stone & Webster Management Association. In accordance with the reorganization plan the properties have been deeded over to the bondholders' committee, which is headed by J. R. Hooper, of the New England Trust Company. A new company is to be incorporated under the laws of New York State and the committee will transfer the properties to this company. The name of the new company has not been announced yet, but it is understood that the capitalization, as planned by the syndicate headed by Boston bankers in charge of the reorganization, will consist of $2,500,000 6 per cent preferred stock, $9,500,000 common stock and $10,000,000 5 per cent fifty-year bonds, of which the initial issue will be $5,000,000. The plan will shortly be submitted to the Public Service Commission of the Second District of New York for its approval.

Earnings of Electric Companies.—Gross earnings of electric companies show increases as follows: Dayton (Ohio) Power & Light Company for the year ended April 30, 1911, $574,645, an increase of $121,351 for the year; Dedham & Hyde Park Gas & Electric Light Company for the year ended June 30, 1911, $58,058, an increase of $6,845; Massachusetts Lighting Companies for the year ended June 30, 1911, $1,213,185, an increase of $235,626; Portland (Maine) Electric Company for the year ended July 31, 1911, $472,974, an increase of $86,928; Rockville-Willimantic Lighting Company, Connecticut, for the year ended Dec. 31, 1910, $136,134, an increase of $16,560; Union Electric Company, of Dubuque, Ia., for the year ended July 31, 1911, $398,701, an increase of $16,085; Weymouth Light & Power Company, of East Weymouth, Mass., for the year ended June 30, 1911, $60,189, an increase of $8,726.

Two Independent Telephone Companies in New York State Sold to Bell Interests.—The Friendship Telephone Company, a holding company of the Bell interests, has purchased the Auburn and Skaneateles Telephone companies in western New York State. These companies were formerly allied with the independent system headed by the Federal Telephone Company, which recently blocked the sale of the Rochester independent company to Bell interests. According to an official statement relative to acquisition of these two independent companies, the outstanding securities of the two companies involved are something over $400,000 and the payment to the holders is about $175,000.

Record Earnings of Philadelphia Rapid Transit Company.—Gross passenger earnings of the Philadelphia Rapid Transit Company in the quarter ended Sept. 30 were $5,298,373, larger returns than for any corresponding period in the history of the company. Miscellaneous income from other sources including trolley freight service brought this figure to $5,551,157. Operating expenses were $3,398,546 and net earnings were $2,152,610. Fixed charges were $2,211,170, leaving a deficit of $58,560 for the quarter. September earnings were $1,810,129; miscellaneous income was $89,221, making a total revenue for the month of $1,899,351, an increase of 8.05 per cent as compared with that in September, 1910. Operating expenses were $1,127,562, and net earnings were $771,788. Fixed charges were $737,198, leaving a surplus for the month of $34,590, which was largely responsible for the reduction in the deficit for the quarter ended Sept 30.

Mexican Light & Power Company, Ltd.—The statement of combined earnings of the Mexican Light & Power Company, Ltd., and the Pachuca Light & Power Company for September shows gross earnings, Mexican currency, of $693,559 as compared with $756,241 in September, 1910. Net earnings of the two companies were $527,861 as compared with $565,471 in the corresponding month of the previous year. Gross earnings of the two companies from Jan. 1 were $6,026,453, as compared with $5,148,324 in the corresponding period of 1910.

Minneapolis General Electric Increases Dividend.—A quarterly dividend of 2 per cent on its common stock, payable Nov. 1 to stockholders of record Oct. 18, has been declared by the Minneapolis General Electric Company, which places the issue on an 8 per cent basis. From August, 1910, to August, 1911, the quarterly rate was 1¾ per cent; from November, 1909, to May, 1910, the rate was 1½ per cent, and from 1906 to August, 1909, the semi-annual rate was 2 per cent.

Applications to List Public Utility Securities on New York Exchange.—Application has been made to list $6,261,000 additional unifying and refunding mortgage 5 per cent bonds of the California Gas & Electric Corporation, of San Francisco, Cal., due 1937, and $55,086,500 additional capital stock of the American Telephone & Telegraph Company upon the New York Stock Exchange.

DIVIDENDS.

Jacksonville Traction Company, quarterly, preferred, $1.50 per share; common, $1.75 per share; both payable Nov. 1.

Lewiston, Augusta & Waterville Street Railway Company, quarterly, preferred, 1½ per cent, payable Nov. 1.

McCrum-Howell Company, quarterly, preferred, 1¾ per cent, payable Nov. 2.

Minneapolis General Electric Company, quarterly, common, 2 per cent, payable Nov. 1.

Montreal Light, Heat & Power Company, quarterly, 2 per cent, payable Nov. 15.

North American Company, quarterly, 1¼ per cent, payable Jan. 2.

Sierra Pacific Electric Company, quarterly, preferred, $1.50 per share, payable Nov. 1.

REPORTS OF EARNINGS.

HUDSON & MANHATTAN RAILROAD COMPANY.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
Sept.,	1911	$377,007	$161,451	$215,556	$209,702	$5,854
Sept.,	1910	323,483	151,487	171,706	191,596	*19,890

PORTLAND (ME.) ELECTRIC COMPANY.

Yr. July,	1911	$472,974	$210,650	$262,324	$159,319	$103,005
Yr. July,	1910	386,046	136,776	249,270	150,932	98,338

RIO DE JANEIRO TRAMWAY, LIGHT & POWER CO.

Sept.,	1911	$1,118,664	$523,881	$594,783	———	———
Sept.,	1910	982,762	474,614	508,148	———	———

SAO PAULO TRAMWAY, LIGHT & POWER CO., LTD.

Sept.	1911	$312,740	$110,908	$201,832	———	———
Sept.	1910	260,829	92,037	168,792	———	———

*Deficit.

General News

Construction News.

COLUMBIA, ALA.—The city of Columbia has contracted with the Omussee Light & Power Company to supply electricity for lighting the streets and residences in Columbia. The company has developed the water power at the falls at Wood's Mill, on Omussee Creek, about 3 miles from the city. The company will give a twenty-four-hour service. It is reported that a bonding company has offered to purchase the water rights and develop the entire power for the purpose of generating electricity to be transmitted to Columbia, Dothan, Slakely, Georgia, Headland and Ashford.

MONTGOMERY, ALA.—In a report submitted by the Water Works Department to the City Commissioners recently the installation of an electric air compressor costing $15,000 was recommended.

PIEDMONT, ALA.—At an election held recently the proposition to issue bonds to the amount of $25,000, the proceeds to be used for the installation of a municipal electric-light plant and for extensions to the water-works, was carried. The electric plant will be erected on a site purchased during the administration of Mayor C. E. Harris. The cost of the plant and extensions to the water-works system is estimated at about $20,000, bids for which have already been received. The street-lighting system will consist of sixty-five lamps. It is expected to have both systems completed by Jan. 1, 1912.

CROWN KING, ARIZ.—It is reported that plans are being considered by the Arizona Power Company for the erection of a transmission line between Crown King and Poland Junction, via Mayor and Blue Bell. M. V. Watson, of Prescott, is manager.

DOUGLAS, ARIZ.—The Douglas Improvement Company is contemplating enlarging its power plant and the construction of a transmission line through the valley with a view of supplying electricity for operating pumps for irrigation purposes.

YUMA, ARIZ.—The Yuma Electric & Water Company is preparing to build an addition to its electric-power plant, for which a permit has been taken out. Samuel DeCorse is superintendent.

JONESBORO, ARK.—Arrangements are being made by J. F. Christy, manager of the municipal water and light plant, for the erection of tungsten lamps to replace arc lamps now in use. The system will be extended to parts of the city now without lighting service.

BAKERSFIELD, CAL.—The Reward Oil Company has erected a new transformer station and will install electric motors for oil-drilling operations.

BERKELEY, CAL.—The Oakland Traction Company has applied to the Council for a franchise from Berkeley to the northern boundary of Alameda County.

BERKELEY, CAL.—The Sierra & San Francisco Power Company has notified the City Council of its intention to extend its system to Berkeley. E. J. Blanchard is secretary of the company.

BIG OAK FLAT, CAL.—Plans are being considered for the installation of electric-hoisting and air-compressor machinery at the Dutch mine.

CORCORAN, CAL.—Plans are being considered by G. Brandenburg for the installation of electric pumping plants on his Homeland tract, in Corcoran.

LAKEPORT, CAL.—The Board of County Supervisors has granted James A. Gunn, Jr., a fifty-year franchise to erect and maintain electric transmission lines over the county roads and public streets in Lake County.

LINCOLN, CAL.—A committee, consisting of L. E. Brown, Walter Jansen and C. E. Finnie, has been appointed to make arrangements for lighting the streets of the city.

LOCKEFORD, CAL.—The Central California Traction Company is contemplating the construction of a line from Campton to Lockeford, work on which will begin soon.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has applied to the Board of Public Utilities for permission to equip the Southern Pacific Santa Monica steam line for electrical operation.

LOS ANGELES, CAL.—The Newberry-Bendheim Electric Company has been awarded the contract for the installation of an electric-light system, including 1000 tungsten lamps of 25 cp, for the Third Church of Christ, at $2,430.

LOS ANGELES, CAL.—The Llewellyn Iron Works, of Los Angeles, Cal., have secured the contract for installing four direct-connected electric freight elevators in the five-story building being erected at Second and Central Avenues for the Haas Building Company. Morgan, Walls & Morgan, of Los Angeles, Cal., are the architects.

MARICOPA, CAL.—Edward Gillette, operating coal properties, is contemplating the installation of electric motors for drilling purposes.

MENTONE, CAL.—The Pacific Light & Power Company is planning to build an addition to its transformer station at Mentone.

PLANADA, CAL.—The Planada Development Company, of Los Angeles, Cal., has awarded the Ornamental Cement Stone Company a contract for seventy concrete lamp standards for a street-lighting system in Planada.

SACRAMENTO, CAL.—A general engineering and construction company has been organized in Sacramento, of which W. P. Ireland, of Gold Run, Placer County, is manager. The company has made preliminary contracts for surveying and other work preparatory to the development of a large water and electric power project on the Yuba and Bear Rivers for the purpose of supplying electricity to the cities of central California. The company will also supply water for domestic and irrigation purposes. The work contemplated by the company will involve an expenditure of about $5,000,000. James D. Stewart, lessee and general manager of the United Water & Power Company, of San Francisco, Cal., is interested in the project. The company will soon be incorporated.

SAN DIEGO, CAL.—The San Diego Southern Railway Company is planning to build its electric system between San Diego and Otay.

SAN FRANCISCO, CAL.—The contract for furnishing and installing turbines, generators and main switchboard in the power house and laundry building of the San Francisco Hospital has been awarded to Frederick C. Roberts & Company, for $25,198. Robert Dalziel, Jr., has been awarded the contract for furnishing and installing boilers, boiler-rooms and piping in power house and laundry, at $52,897.

SAN FRANCISCO, CAL.—At a special meeting of the stockholders of the Pacific Gas & Electric Company, it is reported that the stockholders voted to create a new mortgage under which bonds to an amount not exceeding $150,000,000 may be issued from time to time, and to increase the capital stock to an amount sufficient to enable it to comply with the California statute under which no corporation may have outstanding indebtedness in excess of its subscribed capital stock. The proceeds of the bonds will be used for refunding or retiring existing issues of the company and its susidiaries, amounting to $67,000,000, and the remainder will be reserved for extensions and improvements.

SIERRA CITY, CAL.—Plans are being considered by the Sierra Buttes Mine Company for the construction of two hydroelectric power plants on Sardine and Salmon Lakes. The proposed plants will have a total generating capacity of 20,000 hp. J. C. Folsom is superintendent.

TROPICO, CAL.—The Glendale Light & Power Company has submitted a proposition to the city offering to furnish 32-cp street lamps at $1 each per month, the city to pay the cost of installation and for renewal of all lamps.

COLORADO SPRINGS, COL.—It is reported that bids will be received until Nov. 6 for the construction of a power plant for the tuberculosis colony of Modern Woodmen of America at Colorado Springs.

DENVER, COL.—The Mountain States Telephone Company is contemplating extensive improvements and extensions to its properties, involving an expenditure of about $2,000,000, during 1912.

DOVER, DEL.—The Standard Gas & Electric Company, incorporated by Chicago parties, has filed an amendment to its charter with the Secretary of State at Dover, Del., increasing its capital stock from $24.000,000 to $45,000,000.

WILMINGTON, DEL.—The Public Utilities Light, Heat & Power Company has applied to the Street and Sewer Department for a franchise to construct and operate an electric-light plant in Wilmington.

TAKOMA PARK, D. C.—Sealed proposals will be received by Benjamin G. Davis, 110 Oak Avenue, Takoma Park, D. C., until Nov. 13 for supplying 100 electric lamps of at least 40 cp for lighting the streets of the town of Takoma Park, Md., for a term of two years.

WASHINGTON, D. C.—Sealed bids will be received at the office of the Chief Signal Officer, War Department, Washington, D. C., until Oct. 28, under proposal No. 555 for furnishing 4 miles of rubber-insulated submarine cable, type 51. For further information address Captain R. J. Burt, disbursing officer.

AUGUSTA, GA.—Plans are being considered for the installation of ornamental lamp standards to be erected on Broad Street. It is proposed to erect forty-four standards, each carrying two lamps.

MANCHESTER, GA.—The Manchester Commercial Club has voted to request the City Council to call an election to vote on the proposition to issue bonds to install a municipal electric-light plant in Manchester. A committee was appointed to confer with the Council to determine the amount of bonds to be issued and the date of the election, etc.

ST. SIMON, GA.—Application has been made to the Georgia Railroad Commission to give the St. Simon Railway Company authority to issue $50,000 in bonds. Of the proceeds $18,000 is to be used to cover the cost of the railway, $12,000 to provide for additional equipment, and $20,000 to be held in reserve for future development. The company owns and operates an electric railway extending from the pier at St. Simon to the new Hotel St. Simon. H. F. Dunwody, manager of the Mutual Light & Water Company, of Brunswick, Ga., and others are interested in the company.

VALDOSTA, GA.—President G. W. Varn, of the Consolidated Ice & Power Company, which has the contract for street lighting, has notified the City Council that he desires to surrender the contract. The reason given by Mr. Varn is that the deductions from the bills rendered by the company each month, on account of lamps not burning, are so large that he is now serving the city at a loss.

BOISE, IDAHO.—The property and holdings of the Boise & Interurban Railway Company in Boise, the Boise Valley, Caldwell and intervening points have been purchased by the Kuhn interests, represented by J. S. and W. S. Kuhn, of Pittsburgh, Pa. The deal included the transfer of securities of between $2,000,000 and $3,000,000. Negotiations are said to be under way by the Kuhn interests to purchase the property of the Boise Valley Railway Company and the Boise Railroad Company, both of Boise. The Kuhn interests now own a chain of power plants from Twin Falls in the east along the Snake River in Southern Idaho to Boise, and on as far west as Weiser. Their plan is eventually to control all power plants in this section of the State to supply southern Idaho with electricity for motors, lamps, irrigation, pumping and heating purposes.

MOUNTAIN HOME, IDAHO.—Work has commenced on the construction of a hydroelectric plant on the Snake River, near Mountain Home, by the Smith, Kerry & Chace Engineering Company, of Portland, Ore. It is estimated that 14,000 hp can be developed. The company has entered into a contract with the Gem Irrigation District to supply electricity for pumping water for irrigating purposes. About sixty miles of transmission line, with distributing branches, will be erected.

TWIN CITY, IDAHO.—The Twin Falls Street Railway Company has been granted a fifty-year franchise to construct and operate an electric railway on certain streets of the city.

BELLEVILLE, ILL.—Plans are being considered by the Retail Merchants' Association for the installation of an ornamental lighting system on Main Street. It is proposed to erect ornamental standards with cluster lamps.

BELMONT, ILL.—Preparations are being made for the installation of an electric plant in Belmont.

CHAMPAIGN, ILL.—Proposals will be received by the City Council until Nov. 4 for lighting the streets of the city with electricity, gas or gasoline for a term of ten years. N. M. Woodward is city clerk.

CHATSWORTH, ILL.—The Chatsworth Electric Company is reported to be contemplating the construction of transmission lines to Cabery, Kempton and Cullom.

CHICAGO, ILL.—Bids are being asked by the Metropolitan West Side Elevated Railway Company for the construction of a new substation to be erected at 259 South Franklin Street, Chicago. The building will be one story, of brick, steel and concrete construction.

CLINTON, ILL.—Plans are being considered by Charles Dickerson, commissioner of public buildings, for the installation of electrical pumping machinery at the municipal water-works pumping station.

FREEPORT, ILL.—Plans are being considered by the Freeport Railway & Light Company for improvements to its power plant in Freeport.

GALENA, ILL.—Plans are being considered by the Interstate Light & Power Company for the installation of an ornamental street-lighting system in Galena.

NEWMAN, ILL.—The Newman Electric Light Company, it is reported, will rebuilt its plant, which was recently destroyed by fire.

PAXTON, ILL.—H. L. Clarke, of Chicago, Ill., is endeavoring to interest the citizens of Paxton in an electric-lighting proposition. He proposes to organize a company to construct and operate an electric plant and supply electricity for street lighting and also to operate the city pumping station at a lower rate than the city is now paying. Steps have been taken by the City Council to have a new franchise drawn up. The new company, it is said, will be capitalized at $70,000.

SAYBROOK, ILL.—Negotiations have been consummated between the City Council and the Gibson City Electric Light & Power Company whereby the latter will extend its transmission lines from Gibson City to Saybrook to supply electricity for business purposes at 10 cents per kw-hour and for domestic use at 12 cents per kw-hour.

VIRDEN, ILL.—The City Council is considering the question of improving the street-lighting system in Virden. The Virden Electric Light Company, which holds the present contract for street lighting, is endeavoring to secure a new contract.

ANGOLA, IND.—The City Council is considering the question of installing an ornamental street-lighting system.

DECATUR, IND.—The Holland-St. Louis Sugar Company, it is reported, is planning to erect a beet-sugar plant in Decatur, to cost about $1,000,000. The plant will be equipped throughout for electrical operation. L. G. Ellingham, of Indianapolis, Ind., is interested in the project.

HUNTINGTON, IND.—Plans are being considered by the Shaff Brothers Piano Manufacturing Company to build an addition to its plant. The plans include the installation of electric-generating machinery to supply electricity for lamps and motors for the factory, and also for the adjoining glue plant.

INDIANAPOLIS, IND.—The Board of Public Works is reported to be considering the installation of a power plant in connection with a sewage-disposal plant. H. E. Klausman is city engineer.

INDIANAPOLIS, IND.—The Board of Park Commissioners has notified the Merchants' Heat & Light Company that unless the company improved its lighting system in the parks steps would be taken to cancel the contract.

MUNCIE, IND.—After operating the municipal electric-light plant for thirteen years the city of Muncie has discarded the plant and entered into a contract with the Muncie Electric Light Company to light the streets of the city for a period of ten years.

OSSIAN, IND.—Messrs. Reidel & Gray, of Ossian, Ind., are interested in a project to supply electricity for both street lighting and commercial purposes in this town. Application has been made to the Board of Trustees for a franchise to operate an electric-light system, and if granted the town will be wired and the service established before cold weather sets in.

SHERIDAN, IND.—The Town Board has sold the municipal electric-light plant to J. L. Vickery, of Sheridan. Under the terms of the sale Mr. Vickery is to assume the bonded indebtedness of $9,500 together with the current interest. The new owner will take over the system in November, but is given fifteen months to equip the plant for a twenty-four-hour service. He also proposes to build a water-works system and ice plant in connection with the light plant. The municipal plant was established in 1898 at an original cost of $6,000, and between $10,000 and $12,000 has been expended on the plant since.

SOUTH BEND, IND.—Preparations are being made by the Muessel Brewing Company for the construction of a large addition to its plant, which will be equipped for electric-motor drive.

ALGONA, IA.—It is reported that the $18,000 bond issue voted last summer for improvements to the municipal electric-light plant has been found to be illegal. It is expected that a second vote will be ordered. Part of the funds have been used.

ATLANTIC, IA.—It is reported that J. Bortenlanger, who held the contract for construction of the water and light plant in Atlantic, has thrown up his contract and the bonding company will complete the work.

AUGUSTA, IA.—Preparations are being made by L. J. Highland for the construction of a dam on the Skunk River in Augusta, the power to be utilized to generate electricity.

BOONE, IA.—The proposition to grant the Boone Electric Company a franchise to install a central heating distributing plant will be submitted to a vote on Oct. 30.

OSKALOOSA, IA.—The Des Moines River Power Company, it is reported, has notified the officers of the Oskaloosa Traction & Light Company that it will exercise its options on the Oskaloosa properties. The Oskaloosa Company operates the electric-light, heating plant and street-railway system, and also the Oskaloosa & Buxton Interurban Railway.

PRAIRIE CITY, IA.—The proposition to grant a franchise to the Colfax Electric Light Company, of Colfax, Ia., to install an electric-light system in Prairie City will be submitted to the voters on Oct. 30.

ROCKWELL CITY, IA.—The plant and holdings of the Rockwell City Electric Light & Power Company have been purchased by William Webb, of Sac City, Ia. The consideration is said to be about $20,000. Mr. Webb will take over the management of the plant about Nov. 1.

HORTON, KAN.—Extensive improvements are being made to the electric plant of the Horton Water & Light Company. As soon as improvements are completed a new street-lighting system will be installed. It is proposed to discard the arc lamps now in use and install ninety tungsten lamps. The question of erecting ornamental lamps in the business section is under consideration by the merchants.

INDEPENDENCE, KAN.—The State Utilities Commission, it is reported, has granted the Union Traction Company of Kansas permission to issue bonds to the amount of $450,000, the proceeds to be used to build an electric railway from Cherryvale to Parsons, Kan.

MEADE, KAN.—The Meade Telephone Company, it is reported, has received permission from the State Utilities Commission to issue bonds to the amount of $20,000, the proceeds to be used for improvements to its system.

MORRILL, KAN.—Preparations are being made for the installation of a municipal electric-light plant in Morrill. Bids for machinery have been called for. Malin Litchty is city clerk and G. E. Johnson engineer.

NEWTON, KAN.—The State Utilities Commission, it is stated, has granted the Kansas Gas & Electric Company permission to issue bonds to the amount of $20,000, the proceeds to be used to purchase the property of the Newton Telephone Company and make extensions to the Wichita line.

LOUISVILLE, KY.—The Kentucky Electric Company is contemplating furnishing steam heat in the business portion of the city.

SHREVEPORT, LA.—At an election held Oct. 17 the proposition to issue bonds to the amount of $310,000 to construct a municipal electric-light and power plant was defeated.

BINGHAM, MAINE.—The local power house of the Central Maine Power Company was destroyed by fire on Oct. 10, leaving the town without electrical service. The company is now erecting a transmission line from Skowhegan to Bingham, which will be ready for operation in a short time.

CORINNA, MAINE.—The Central Maine Power Company is extending its transmission line from the main power line between Dexter and Pittsfield to Corinna to supply electricity here. The local electric-light

plant was burned several weeks ago, and the town has been without electrical service since.

DOVER, MAINE.—The Greenville Light & Power Company has purchased the plant and holdings of the Dover & Foxcroft Light & Heat Company.

HARTLAND, MAINE.—The Hartland Electric Light & Power Company has filed amendments to its charter increasing its capital stock to $25,000.

BALTIMORE, MD.—Application has been made to the County Commissioners to extend the electric-light system to Randallstown, a distance of 3 miles from the present terminus of the line.

FT. WASHINGTON, MD.—Bids will be received at the office of the quartermaster, Ft. Washington, Md., until Oct. 31 for furnishing miscellaneous electrical supplies. For further information address Lieut. D. N. Swan, Jr., quartermaster.

CHICOPEE, MASS.—The Board of Aldermen has voted to appropriate $96,000 for rebuilding and enlarging the municipal electric-light plant.

MALDEN, MASS.—The City Council has rejected the contract recently submitted by the Malden Electric Company for lighting the streets of the city for a term of ten years and has asked that the entire matter be referred to the Board of State Gas and Electric Light Commissioners. The company offered to reduce the price of arc lamps from $100 to $98 each per year and similar reduction on other lamps.

ANN ARBOR, MICH.—Plans have been completed by the Eastern Michigan Edison Company for the erection of an electric-generating plant at Ann Arbor, involving an expenditure of $250,000. The proposed plant will be located on the Huron River, near the water-works pumping station, where a dam will be built which will form a pool or basin covering about 300 acres. This will be known as the Barton plant, and will have an output of 800 hp, which will be supplied to the customers of the Washtenaw Light & Power Company in Ann Arbor, Ypsilanti, Saline, Wayne and Dearborn. When this plant is completed the Argo dam will be removed and the Argo generating plant will be used as a substation. Contracts for erection of the plant will be awarded within thirty days.

DETROIT, MICH.—The Hupp Corporation has awarded the contract for the construction of its new power plant to the Rutley Construction Company, of Detroit, Mich.

HANCOCK, MICH.—It is reported that the City Council is considering the question of installing a municipal electric-light plant in Hancock. It is expected that the proposition will be submitted to the voters at the election next spring.

JACKSON, MICH.—It is reported that preliminary arrangements have been made to lease the property of the Michigan United Railways Company for a period of 999 years to a corporation which will start with a paid-up capital stock of $2,000,000. Under the terms of the proposed lease the Michigan United Railways Company is to make extensions and improvements to its property, involving an expenditure of $3,265,000, which will be met by an issue of bonds.

REED CITY, MICH.—Part of the dam of the Osceola Light & Power Company, of Reed City, was carried away recently, causing the electric plant to be closed down. The city is now without electrical service, and probably will be for some time.

DULUTH, MINN.—Plans have been prepared by Oscar Claussen, of St. Paul, Minn., and Charles L. Pillsbury, of Minneapolis, engineers, for the installation of a municipal electric-light plant, to cost approximately $901,798. The cost of the power house and machinery is estimated at $240,000; overhead distributing system, $272,855; underground distributing system, $85,000, and meters, $72,000. The plans also include an emergency plant to secure power from the Great Northern Power Company.

HENDRICKS, MINN.—A franchise has been granted to Ernest Smelser to install and operate an electric-light system in Hendricks.

KERHOVEN, MINN.—The installation of a municipal electric-light plant is reported to be under consideration.

MINNEAPOLIS, MINN.—The Center Improvement Association is conducting a campaign to secure funds for the installation of 147 ornamental lamps, to cost $7,025.

MINNEAPOLIS, MINN.—The public lighting committee is contemplating remodeling the electric-light plant in the court house and the city hall with a view of providing electricity to operate 200 ornamental street lamps. It is understood that a consulting engineer will be engaged and bids called for the work.

MINNEAPOLIS, MINN.—Plans are being considered by the City Council for the installation of ornamental lamps in the central district. It is proposed to erect 130 additional ornamental lamps for which the Board of Tax Levy recently appropriated $7,500, with $4,200 for maintenance during the year 1912. The Bridge Square Improvement Association is also advocating the erection of ornamental lamps on Washington Avenue, between the Milwaukee & Minneapolis and St. Louis stations on Hennepin and Nicollet Avenues and First Avenue, between Washington Avenue and High Street, and in the vicinity of the Soo line station.

NEW ULM, MINN.—In a report submitted by Earle D. Jackson, of St. Paul, Minn., the installation of an additional engine and generator at the electric-light and water-works plant, to cost $3,800, is recommended, instead of the construction of a condenser and cooling tower, the cost of which is estimated at $11,000.

OWATONNA, MINN.—A. L. Ober, of Chatfield, Minn., who was granted a franchise some time ago, is planning to erect another power plant in Owatonna to supply electricity from the Zumbro River to Byron, Rochester, Dodge Center, Kasson, Claremont and Owatonna.

RED LAKE FALLS, MINN.—The city of Red Lake Falls is considering the question of granting an electric-light and power franchise, for which proposals have already been called for.

WARBA, MINN.—It is reported that the village of Warba will soon be lighted by electricity. Energy for operating the system will be supplied by the electric plant of the Warba Hardwood Manufacturing Company.

WINONA, MINN.—Arrangements are being made for extensive improvements to the light, power and water service of the Winona Railway & Light Company, which will involve an expenditure of about $20,000. The company is now in the hands of a receiver.

WYKOFF, MINN.—The proposition to install an electric-light system in Wykoff, the cost not to exceed $3,000, will be submitted to a vote.

KANSAS CITY, MO.—The question of installing a new ornamental street-lighting system in the business section of the city is under consideration.

HELENA, MONT.—Judge Carl Rasch in the federal court has appointed George F. Shelton, of Butte, Mont., receiver of the United Missouri River Power Company, which owns the Canyon ferry, the Hauser Lake and the uncompleted Holter hydroelectric plants on the Missouri River. The receiver was appointed at the request of the United States Mortgage & Trust Company, of New York, N. Y., which holds $12,500,000 in bonds of the company.

MISSOULA, MONT.—The Clark Street Railway Company is planning to build an electric railway from Missoula to the foot of Flathead Lake.

RUBY, MONT.—Plans are being considered by the Madison River Power Company for the installation of a lighting and power system between Ruby and Virginia City. A transformer station is to be erected at Laurin.

CENTRAL CITY, NEB.—The City Council is reported to have decided to replace the present arc lamps with tungsten lamps for street lighting.

KEARNEY, NEB.—Plans are being considered by the City Council for the installation of a municipal electric-light plant, for which plans and estimates have been prepared. It is proposed to operate the plant in connection with the city water-works system. An extra boiler is available at the water plant, and all that would be required is an extra engine and electric generator. The present plan is to light all of Central Avenue from Nineteenth Street to the Midway Hotel, using ornamental standards with cluster lamps. In addition it is proposed to furnish electricity for 217 lamps at street intersections and public parks and school houses in the city.

NELIGH, NEB.—Plans are being considered by the business men to install an ornamental lighting system on the business streets of the city. It is proposed to replace the present arc lamps with cluster lamps erected on ornamental standards.

NORFOLK, NEB.—Extensive improvements and additions are being made by the Norfolk Electric Light & Power Company to its property in this city, including the construction of a new power house and the installation of a 500-kw generating unit, consisting of a heavy duty compound condensing engine and a three-phase generator.

OVERTON, NEB.—The Village Board is reported to have granted a franchise to W. W. Hill to construct and operate an electric-light plant for a period of twenty years. The town has contracted for twenty street lamps.

MENDHAM, N. J.—The Borough Council has granted the Bernards Electric Company a forty-year franchise and has also entered into a contract for street lighting for a period of five years. Under the terms of the contract the company is to supply at least forty lamps at the rate of $18 per lamp per year and to supply electricity to private consumers at a maximum rate of 15 cents per kw-hour. The Bernards company, which is controlled by the Eastern Pennsylvania Light & Power Company, has agreed to make improvements to its plant and distributing system and to be ready to furnish the service within seventy-five days.

SPRING LAKE, N. J.—The Borough Council is considering the question of establishing a municipal electric-light plant in conjunction with the new water-works system.

TRENTON, N. J.—Arrangements are being made by the Public Service Electric Company to supply electricity from the local plant on Chancery Street in Princeton, Monmouth Junction, Cranbury, Skillman, Hopewell and other nearby places. When the necessary changes are made at the local plant the power house at Rocky Hill will be abandoned. Machinery to provide for 2000 additional hp will be installed at the Chancery Street plant.

AUBURN, N. Y.—Announcement has been made that the plant and holdings of the Auburn Telephone Company, together with the Skaneateles and Allied Telephone Companies in Onondaga and Cayuga counties, have been purchased by the Bell interests through the Friendship Telephone Company, a holding company. These companies have heretofore been independent and were among the larger components of the system of the Federal Telephone Company.

BINGHAMTON, N. Y.—Application has been made to the City Council

by Peters Brothers, of Chenango Forks, for a franchise to supply electricity for lamps, heat and motors in Binghamton. The firm of Peters Brothers is planning to erect a large hydroelectric plant on the Chenango River in Chenango Forks.

GLENS FALLS, N. Y.—The Stone & Webster Management Association, of Boston, Mass., has taken over from the receivers the physical direction of the eight companies of the Hudson River Power Company. As a further step to their rehabilitation the various affiliated Hudson River properties have been deeded over to the bondholders' committee, headed by James R. Hooper of the New England Trust Company, which will in turn transfer them to the proposed new company to be incorporated under New York laws. The name of the new company has not yet been decided, but according to the reorganization plan, which will in the immediate future be formally submitted to the New York Public Service Commission for approval, the capitalization of the new company will be $2,500,000 preferred stock, $9,500,000 common stock, and $10,000,000 in bonds, of which only $5,000,000 will be initially issued.

GOUVERNEUR, N. Y.—The Northern Power Company is contemplating the erection of another transmission line from its power plant located at Hannawa Falls to Gouverneur, via Edwards and Fullerville. The company expects to supply about 800 hp in the village of Edwards for power purposes alone. The zinc plant now being erected near the village will utilize electricity to operate its plant, and the power company will also furnish energy to the Ontario Talc Company as soon as preparations are completed to increase the output of the latter company's plant.

LONG ISLAND CITY, N. Y.—It is stated that the contract awarded by the Long Island Railroad Company to P. H. Clements & Company recently includes the equipment of the entire railway from Long Island City to Port Washington for electrical operation.

NEW YORK, N. Y.—Bids will be received by Patrick A. Whitney, Commissioner of Correction, Department of Correction, 148 East Twentieth Street, New York, N. Y., until Oct. 31, for furnishing material and erecting addition to power plant on Hart's Island, to be used as engine and dynamo room. Blank forms and further information may be obtained and plans and drawings seen at the above office.

OLEAN, N. Y.—The special lighting committee appointed to confer with the Olean Electric Light & Power Company to try to secure a reduction in the rate for street lighting has adopted a resolution that the proposition to install a municipal electric-light plant, to cost $75,000, be submitted to the voters at the general election to be held Nov. 7. The Olean Electric Light & Power Company has submitted a proposition offering to supply street arc lamps at $65 each per year, provided the city use 250 lamps for a period of ten years. The city now pays $72 per year for about 150 lamps.

OSWEGO, N. Y.—Plans are being considered for the installation of an ornamental street-lighting system in the business district of the city.

ROCHESTER, N. Y.—E. W. Edward & Son are planning to build a power house in connection with their new department store at St. Paul and Division Streets, Rochester. Crandall & Strobell, of Rochester, N. Y., are architects.

ROCHESTER, N. Y.—The Board of Contract and Supply has awarded the Rochester Railway & Light Company the contract for lighting 300 fire-alarm boxes at the rate of $22.63 each per year, making a total of $6,789. The rate last year was $25 per lamp; the reduction in price is due to the increase in the number of lamps, as but 200 lamps had been installed last year.

THOUSAND ISLAND PARK, N. Y.—Plans are being considered by the Thousand Island Park Association for the installation of a heating, lighting and power plant at Thousand Island Park next year. The cost of the plant is estimated at $7,500. J. P. Lewis, of Beaver Falls, N. Y., is president.

AZALEA, N. C.—The Azalea Woodworking Company, it is stated, would like to receive prices on a generator with sufficient output to supply electricity for sixty lamps and a Corliss engine.

MORGANTON, N. C.—The City Council has granted H. L. Milner a franchise to install an electric-light system in Morganton.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has sumbitted a proposal to the City Council for a renewal of the street-lighting contract as follows: For arc lamps, $60 each per year and $21 each per year for incandescent lamps on a five-year contract, and $55 per year per lamp for arc lamps and $19.75 each year for incandescent lamps on a ten-year contract, with all-night and every-night service. The rates under the new contract are considerably lower than the city is now paying for the service. The present contract expires Oct. 12, 1912.

CINCINNATI, OHIO.—Plans have been completed by the Cincinnati, Hamilton & Dayton Railroad Company for the installation of a telephone dispatching system on its main lines between Cincinnati and Toledo, Ohio, and between Hamilton, Ohio, and Indianapolis, Ind.

CLEVELAND, OHIO.—The City Council has adopted a resolution providing for the appointment of a committee to make an investigation of the rates of electricity for lamps now charged by the Cleveland Electric Illuminating Company. This action was brought about through an introduction of a measure fixing the maximum rate at 8 cents per kw-hour and the minimum at 4 cents per kw-hour. The question of submitting the proposition to issue $2,000,000 in bonds for extensions to the municipal lighting plants to the voters is under consideration.

FREMONT, OHIO.—The City Council has adopted a resolution authorizing the service director to call for bids to be opened on Nov. 21 for a new contract for lighting the streets for a period of ten years, involving an expenditure of $150,000. Plans and specifications for the new contract have been prepared by F. Froehlich, of Toledo, Ohio. The Fremont Yaryan Company has the present contract for street lighting, which has expired.

MARTIN'S FERRY, OHIO.—The City Council is considering the question of purchasing new arc lamps for lighting the streets of the city.

BROMIDE, OKLA.—The Bromide Ooolitic Stone Works, it is reported, are in the market for a 150-kw, alternating-current, three-phase generator.

MULDROW, OKLA.—F. R. Stone, of Lima, Ohio, is reported to have secured the contract for the construction of the combined electric-light plant and water-works pumping station for the city of Muldrow, at $26,760.

SULPHUR, OKLA.—The Rapid Transit Interurban Company, of Tecumseh, Okla., is reported to be contemplating the installation of an electric plant to supply electricity to cities along the route of its proposed railway.

TULSA, OKLA.—All bids submitted for the installation of gas and electric fixtures in the county court house are reported to have been rejected by the Board of County Commissioners, as all were in excess of the architect's estimate. The clerk has been notified to call for new bids and the architect was instructed to prepare specifications calling for less expensive goods.

ALBANY, ORE.—The City Council has revoked the franchise of the Portland, Eugene & Eastern Railway Company on all streets where tracks have not been laid.

BAKER, ORE.—The Central Oregon Power & Irrigation Company, recently organized, is planning to irrigate a large tract of land in Harney County. The company proposes to utilize electricity generated by water-power of Blitzen River to pump water from Malheur Lake for irrigation purposes. The first unit to be irrigated will consist of 10,000 acres. It is estimated that there is sufficient power and available water and land to increase the project to 40,000 acres. Surveys are being made under the direction of C. W. Parrish, irrigation engineer of the Pacific Power & Light Company, who is one of the incorporators. W. A. Pope and S. S. Stuart are also interested in the enterprise. We are informed that the Pacific Power & Light Company has no connection whatever with the new company.

EUGENE, ORE.—The City Council has passed an ordinance providing for the sale of $25,000 in bonds for street lighting. Tungsten series lamps, it is said, will be installed.

EUGENE, ORE.—The City Council has refused the offer of the Oregon Power Company to purchase the municipal electric-light plant. The city is planning for the installation of a complete transmission and distributing system from the municipal plant at Waterville, bonds for which were recently voted.

LENTS, ORE.—The Commercial Club is considering plans for lighting the streets of the town by electricity.

MYRTLE CREEK, ORE.—The City Council is planning to increase the output of the municipal lighting plant, for which machinery is being purchased.

ALTOONA, PA.—The Penn Central Light, Power & Heat Company is extending its transmission line to the powder works at Horrell station to supply electricity to operate the works. The line is being erected over Brush and Scotch Mountains.

CARLISLE, PA.—The City Council has passed a resolution authorizing the installation of an ornamental lighting system for the public square. It is proposed to erect twelve ornamental lamp standards carrying cluster lamps at each of the six corners and four arc lamps at the avenue intersections. Five or eight lamps will be erected on each standard. At present there are nine arc lamps. The cost will be paid by the churches, several banking concerns, County Commissioners, the borough and the Carlisle Gas & Water Company.

PHILADELPHIA, PA.—Sealed proposals will be received by Joseph F. Hasskarl, director, at the Department of Wharves, Docks and Ferries, 55 Bourse Building, Philadelphia, Pa., until Nov. 1, for furnishing electrical apparatus for Vine Street Pier and immigrant quarters. The cost of the work is estimated at $5,500.

PINE GROVE, PA.—An effort is being made to install an electric-light system in Pine Grove. F. H. Hochrath, of Philadelphia, is interested in the project and proposes to furnish the service through the plant of the Tremont & Pine Grove Electric Light, Heat & Power Company, which is located in Tremont. At present the streets of the town are lighted by oil lamps.

RED BANK, PA.—The Red Bank Electric Company has filed a certificate showing an increase in its indebtedness to the amount of $10,000.

ROYERSFORD, PA.—The City Council has decided to submit the proposition to estaolish a municipal light plant in Royersford to a vote at the November election.

SHARON, PA.—The City Council is considering the question of establishing a municipal electric-light plant, to cost approximately $50,000.

BLUNT, S. D.—The local electric-light plant, owned by the Aberdeen Engineering Company, has been purchased by Frank J. Gunsalus, of Blunt. The price paid for the plant was $15,000, and includes city fran-

chise, contract and power plant. G. A. McLaughlin, of Aberdeen, S. D., is president and manager of the Aberdeen Engineering Company.

FLANDREAU, S. D.—The installation of an electric-light plant in Flandreau is reported to be under consideration. Foster Philips is said to be interested in the project.

GARRETSON, S. D.—Investigations are being made by J. A. Wiberg, of Luverne, Minn., with a view of installing and operating an electric-light plant in Garretson.

PHILIP, S. D.—Application has been made to the City Council by F. E. Morrison for a franchise to establish an electric-light plant in Philip.

PIERRE, S. D.—The United States government is installing an electric-light plant at the Cheyenne River agency.

STICKNEY, S. D.—It is reported that local capitalists are organizing a company for the purpose of establishing an electric-light plant in Stickney.

CHATTANOOGA, TENN.—Plans are being considered by the East Tennessee Telephone Company for further extension of its telephone cables, which will involve an expenditure of from $30,000 to $35,000.

LONSDALE, TENN.—The Council has granted the Eastern Tennessee Power Company a franchise to supply electricity in Lonsdale.

BRYAN, TEX.—Arrangements have been made by the City Council for issuing $23,000 in bonds for improvements to the public utility plants, of which $7,000 will be used for the electric-light plant.

CAMERON, TEX.—Extensive improvements are contemplated by the Cameron Water, Power & Light Company, which will involve an expenditure of about $18,000. Plans for the proposed improvements have been prepared by N. Warrenfield, of Dallas, Tex. The company was recently awarded a contract to supply the city with water and street lighting for a term of twenty years.

COTULLA, TEX.—J. R. Black, of Cotulla, is planning to construct a dam across the Nueces River to form a storage reservoir to supply water to irrigate 12,000 acres of land. A hydroelectric and cotton mill will be installed in connection with this project. Electricity generated by the hydroelectric plant will be transmitted to Cotulla and other places in this vicinity.

GALVESTON, TEX.—Capital stock of the Galveston-Houston Electric Company to the amount of $300,000 is being offered for sale, the proceeds to be used for extensions and improvements to the property, to meet the increasing demands made upon the company.

KENEDY, TEX.—A new electric-light plant is being erected in Kenedy by the Kenedy Light & Power Company. The proposed plant will have sufficient output to supply 2000 lamps. The company expects to have the plant ready for operation about Nov. 1 and to establish a twenty-four-hour service about Jan. 1, 1912. Messrs. Autry and McAda are interested in the company.

MIDLAND, TEX.—The City Council has contracted with the Midland Light Company for the installation of a number of additional lamps. The company is planning to improve its plant.

SAN ANTONIO, TEX.—The Medina Irrigation Company, which is constructing a dam and irrigation system near San Antonio at a cost of about $6,000,000, is planning to erect large cotton mills and oil mills and other industrial plants to utilize products that are to be raised upon the land that is to be reclaimed. The main dam will be 170 ft. high, 107 ft. thick at the base, about 50 ft. wide at the top and 1500 ft. long. The reservoir will cover approximately 6000 acres and hold enough water to irrigate 100,000 acres of land. A second reservoir will be built below the main dam by construction of another dam 40 ft. high and about 1000 ft. long. The canals and laterals will have a total length of about 228 miles. Plans have been prepared for the installation of a hydroelectric plant in connection with the irrigation system. The construction of an electric interurban railway to extend from San Antonio through the irrigated property and intermediate towns is contemplated, work on which will soon begin. This company is one of the several projects which F. S. Pearson, of New York, N. Y., and associates are interested in.

SHERMAN, TEX.—An executive committee has been appointed in Sherman to take charge of the work of arranging the details for the construction of an interurban railway between Sherman and Greenville, and also between Gainesville and this city. A fund of $20,000 has been raised to pay for preliminary work on the project. C. B. Dorchester, E. B. Caraway, D. B. Lyon, C. C. Mayhew and Joseph Etter are members of the committee.

TEMPLE, TEX.—The construction of an interurban electric railway between Temple and Marlin, a distance of about 30 miles, is under consideration by a syndicate of Dayton, Ohio, men, headed by Dr. S. F. George. The promoters are asking a bonus of $75,000 from the residents of the towns on the route of the proposed railway. Of this amount the citizens of Temple will be required to donate $50,000.

VICTORIA, TEX.—The City Council has granted the St. Louis, Bronwnsville & Mexico Railway Company a fifty-year franchise to construct and operate a system of motor cars in Victoria. The company is planning to extend its steam railway from Bloomington to Victoria, and the proposed motor-car system in this city will be operated in connection with that line. The company was recently granted a similar franchise in Brownsville.

MONROE, UTAH.—At the special election held Oct. 12 the proposition to issue bonds to the amount of $10,000 to purchase the local electric-light plant was carried.

OGDEN, UTAH.—The Merchants' Light & Power Company has awarded a contract to the Falkenau Electrical Construction Company, of Chicago, Ill., to complete the permanent substation equipment and to erect the main trunk lines which will transmit electricity to all parts of the city for commercial purposes. The entire work will call for an expenditure of about $75,000. The company is now erecting arc lamps for lighting the streets of the city. P. M. Parry is manager.

SALT LAKE CITY, UTAH—The Salt Lake & Ogden Electric Railway Company expects to purchase a 500-kw high-pressure steam turbine for its power plant in Salt Lake City.

ST. JOHNSBURY, VT.—The St. Johnsbury Electric Company is erecting a new power station on the former Carrick property, which it expects to have completed by Jan. 1. This is the fourth station to be operated by the company and will give the company a large supply of power for manufacturing purposes. To encourage new industries to locate in St. Johnsbury the company announces that it is ready to erect a building for any reliable manufacturing firm that may wish to locate there and rent the same for 6 per cent on its actual cost and furnish the company energy at the regular rate. The St. Johnsbury company has extended its system to Danville and will supply electricity for lighting the streets and residences in that village. Preparations are being made to extend its transmission lines to East Johnsbury and Concord. The streets in Concord will be lighted by forty 32-cp incandescent lamps.

DANVILLE, VA.—The Board of Aldermen has approved of the location of the new municipal electric-light plant, which will be erected at a cost of $150,000. The proposed plant will be located on Bridge Street, on what is known as the old Lee Warehouse property.

ELLENSBURG, WASH.—Resolutions have been passed by the City Council creating improvement districts for the installation of street-lighting systems. Cluster lamps will be erected in the business district.

NEWPORT, WASH.—The telephone system of the Newport Telephone Company has been acquired by the Interstate Telephone Company, of Spokane, for a consideration of $25,000. The Newport system will be connected with the long-distance lines.

OTHELLO, WASH.—The Washington Fruit Lands & Irrigation Company is planning to install electric pumping machinery on the Columbia River highlands.

SEDRO-WOOLLEY, WASH.—Bids will be received by the State Board of Control, Olympia, Wash., until Nov. 6 for the erection of a power house and also for mechanical equipment, boilers, engines, etc., for power plant for the Northern Hospital for Insane at Sedro-Woolley. Plans may be seen at the office of Saunders & Lawton, architects, Alaska Building, Seattle, Wash.

SULTAN, WASH.—The city clerk is reported to have been authorized to advertise for bids for the installation of a lighting system.

SPOKANE, WASH.—It is reported that work will soon begin on the construction of the spillway dam at Long Lake, 30 miles north of Spokane, where the Washington Water Power Company proposes to develop 90,000 hp. The proposed dam will be 320 ft. in length, 190 ft. at the highest point and 145 ft. in width at the base, built of cyclopean masonry. The spillway is to be surmounted with three roller dams, each 25 ft. in length and 19 ft. in diameter. The tunnel through which the flow of the Spokane River will be diverted is 225 ft. in length and opens into a cut of 250 ft. The entrance to the tunnel will be of reinforced concrete construction and steel girders. The cost of the entire work is estimated at $4,000,000.

TOPPENISH, WASH.—The Reservation Electric Company is planning to install an electric-lighting system at the Yakima Indian Camp.

MADISON, WIS.—Bids will be received by the State Board of Control, Madison, Wis., until Nov. 1, for rewiring the lighting fixtures for the Northern Hospital for Insane at Winnebago, Wis. Vaughn & Meyer, of Milwaukee, Wis., are consulting engineers.

CHEYENNE, WYO.—It is reported that investigations have been made by a party of capitalists headed by L. D. McCall of power and irrigation projects in the State of Wyoming. As a result of this investigation, it is said, a company will be incorporated with a capital stock of $2,500,000 to develop two water-power sites in Carbon County and irrigate 200,000 acres of land in the Encampment and Saratoga districts.

CALGARY, ALTA., CAN.—The Western Canada Power, Heat & Light Company is planning to lay mains from Bow Island to Calgary, also to Macleod, Claresholm, Granum, Staveley, Nanton, High River and Okotoka.

CALGARY, ALTA, CAN.—Sealed tenders will be received by the City Commissioners, Calgary, Alta., until Nov. 15 for both track and line material for street railway. For further information apply to the City Commissioners.

TRAIL, B. C., CAN.—The Canadian Pacific Railway Company, it is reported, is contemplating equipping its railway from Trail to Rossland, B. C., for electrical operation.

VANCOUVER, B. C., CAN.—The fire and police committee has authorized City Electrician McCrossan to call for bids for the installation of an ornamental street-lighting system on Hastings and neighboring streets. An underground distributing system will be installed, and 250 lamp standards erected.

VANCOUVER, B. C.. CAN.—The Canadian Pacific Railway Company is reported to have acquired a power-plant site on the Adams River, where it proposes to erect a hydroelectric plant. Electricity generated at the proposed plant, it is said, will be used to operate a section of its railway, which will be equipped for electrical operation.

VANCOUVER, B. C., CAN.—The Western Canada Power Company has purchased a site in Vancouver on which it proposes to erect a substation. The property is located on Powell Street, opposite the British Columbia Sugar Refinery Works. It is expected to have the station completed in time to receive energy from the company's hydroelectric plant at Stave Falls the latter part of November.

BEACHVILLE, ONT., CAN.—The village of Beachville is contemplating the installation of an electric-light system, electricity for same to be secured from the Hydroelectric Power Commission The proposition will soon be submitted to the ratepayers.

GALT, ONT., CAN.—The Water Works Commission has decided to utilize Niagara power to operate the water-works pumping plant. It is proposed to use 200 hp to be furnished by the Hydroelectric Power Commission. A by-law was recently passed appropriating $5,000 for improvements to the pumping station.

PORT HOPE, ONT., CAN.—The plant and holdings of the Port Hope Electric Light & Power Company have been purchased by the Seymour Power Company, of Campbellford. Thomas Tuer, superintendent of the plant, has been appointed local manager for the new company.

TORONTO, ONT., CAN.—Tenders will be received until Nov. 1 for the construction of an extension to the power house of the Toronto Power Company, at Niagara Falls, Ont. Plans and specifications may be seen and further information obtained from E. J. Lennox, 164 Bay Street, Toronto, Ont.

GUADALAJARA, MEX.—The Chapala Hydroelectric & Irrigation Company will soon complete the installation of its new hydroelectric plant at Puente Grande, and will remodel and reconstruct its transmission system extending to the Hostatipaquillo and Etzatlan mining districts.

MEXICO CITY, MEX.—The Mexico Light & Power Company, which recently completed the construction of another of its large dams to conserve the water supply for its hydroelectric plant at Necaxa, will soon install additional equipment that will add 30,000 hp to the present output of the plant. Announcement has been made that the Mexico Tramways Company, a subsidiary of the company, which operates the electric-railway system in the federal district and this city, will soon begin work on the construction of an electric interurban railway to extend from this city to Puebla, a distance of 129 miles, and also to Pachuca, a distance of 94 miles.

NAGOLES, MEX.—Plans are being considered by C. W. Phillips and associates for the installation of a hydroelectric plant near the Penn-Sonora gold mines, near Nogales. Other machinery will also be installed.

PARRAL, CHIHUAHUA, MEX.—Edmund Putnam and associates are planning to install an electric hoist and other machinery at the Providencia mine, near Parral.

SAN LUIS POTOSI, MEX.—It is reported that the local street-car system, operated under the name of the San Luis Tramway Company, recently purchased by English interests, will be equipped for electrical operation, work on which will begin in the near future. The same interests, it is said, are negotiating for the purchase of the street-railway system in Tampico. If the deal is consummated the system will be equipped for electrical operation.

New Industrial Companies.

THE ATLANTIC VEHICLE COMPANY, of New York, N. Y., has been granted a charter with a capital stock of $10,000 for the purpose of manufacturing motor vehicles. The incorporators are: Philip A. Carroll, 22 East Forty-seventh Street; Joseph F. Dempsey and Eugene A. Donohue, 59 Wall Street, all of New York, N. Y.

THE AUTOMATIC CALENDAR CLOCK COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $1,000,000 by J. F. Roble, J. D. Rhodes, of Washington, D. C., and A. P. Stevenson, of Wilmington, Del.

THE BURTIS COMPANY, of Trenton, N. J., has been incorporated with a capital stock of $125,000 to deal in electric fixtures, etc. The incorporators are: J. Woolsey Burtis, 3 North Montgomery Street; Alleyne Burtis, 436 East State Street, and Hervery S. Moore, all of Trenton, N. J.

THE DISC-O-PHONE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by William C. Crumlish, of Wilmington, Del.; Howard Bayley, Thirty-first Street and Broadway, and William F. Rea, 456 Broadway, New York, N. Y. The company proposes to manufacture talking machines, records and supplies.

THE DOUBLE-PHONE MANUFACTURING COMPANY, of Boston, Mass., has been granted a charter with a capital stock of $100,000 to manufacture double-phones. E. Berger is president and G. M. Faulkner, of Brookline, Mass., treasurer.

THE GARLAND CONSTRUCTION COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $10,000 for the purpose of doing a general contracting and engineering business, etc. The incorporators are: Edson G. Whitcomb, 48 Powers Building; Gordan Garland, 391 Birr Street, and Everett K. Van Allen, 530 Powers Building, all of Rochester, N. Y.

THE INDIANA GAS ENGINE COMPANY, of Indianapolis, Ind., has been incorporated with a capital stock of $25,000 to manufacture gas engines and all kinds of mechanical and electrical machinery and devices. The incorporators are: Granville G. Westerfield, James W. Comaty, Samuel S. Brewer and Bernard Korbly.

THE INTERNATIONAL MOTOR COMPANY, of New York, N. Y., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $10,000,000, by Richard S. Aldrichs, Graham Foster and Joseph A. Bennett, of New York, N. Y., and Harry W. Davis, of Wilmington, Del. The company proposes to manufacture motors, engines and incidental devices.

THE PAUL LACROIX AUTOMOBILE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 to manufacture and deal in motor vehicles. The incorporators are: Paul Lacroix, 353 West Eighty-fifth Street; Harry U. Kibbe, 258 Riverside Drive; Harvey T. Andrews, 35 Mount Morris Park West, all of New York, N. Y.

THE QUEEN CITY ELECTRIC AUTOMOBILE COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $50,000 by A. C. Towne, of Kenmore, N. Y.; C. S. Chamberlain, 93 Lancaster Avenue, and Moses T. Day, 1212 Prudential Building, Buffalo, N. Y.

THE THERMODYNE ENGINE COMPANY, of New York, N. Y., has been incorporated by William Esson, 161 West 105th Street; W. H. Fritchman and L T. Fetzer, 44 Pine Street, all of New York, N. Y. The company is capitalized at $30,000 and proposes to manufacture machinery, engines, etc.

THE UNION OXY-CARBIDE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000 for the purpose of doing a mechanical engineering business and manufacturing machinery. The incorporators are: G. H. Schwarz, A. M. Bremer and P. A. Rose, of New York, N. Y.

THE UNITED RAILWAY APPLIANCES COMPANY, of Salamanca, N. Y., has been incorporated with a capital stock of $100,000 by J. Harvey, C. Paul and J. E. Maloney, of Salamanca. The company proposes to manufacture railroad appliances and supplies.

New Incorporations.

ATLANTA, GA.—A charter has been granted to the Georgia Railway & Power Company with a capital stock of $27,000,000. The company is to take over the plant and holdings of the Georgia Railway & Electric Company, of Atlanta, and all the hydroelectric plants in the north and northeastern sections of the State. C. Elmer Smith, of York, Pa., is to be president of the company.

BENTON, ILL.—The Egyptian Southern Railway Company has been incorporated with a capital stock of $10,000 to construct an electric railway from McLeansboro to Herrin. The directors are: Walter W. Williams, W. H. Hart, George A. Powers, L. W. Brand, all of Benton, Ill.

BRADFORD, ILL.—Articles of incorporation have been filed for the Central Illinois Interurban Railroad Company, with a capital stock of $100,000. The company proposes to build an electric railway from a point in or near the city of Kewanee, in Henry County, to a point in or near the city of Henry, in Marshall County. The incorporators are: C. N. Gerard, of Bradford, Ill.; E. A. Beadle, of Kewanee, Ill.; H. R. Hess, of Whitefield, Ill.; Howard G. Stener, of Henry, Ill., and H. H. Haines, of Peoria, Ill.

EDWARDSVILLE, ILL.—The Edwardsville Gas & Electric Company has filed articles of incorporation under the laws of the State of Indiana for the purpose of supplying electricity and gas for light, heat and power purposes in Edwardsville, Ill. The incorporators are: Paul J. Scheller, Henry Darmettelle and H. J. Peckinpaugh. The main office of the company will be located in Evansville, Ind.

OLNEY, ILL.—Articles of incorporation have been filed for the Terre Haute & Ohio River Railroad Company for the purpose of building a railway from Clark County, Illinois, opposite Terre Haute, Ind., to Elizabeth, Ill., on the Ohio River. The company is capitalized at $160,000.

EVANSVILLE, IND.—The Central Gas & Power Company has been incorporated with a capital stock of $10,000 for the purpose of operating an electrical distributing system. The incorporators are: P. J. Scheller, Henry Dannettell and H. J. Peckinpaugh.

FERDINAND, IND.—The Ferdinand Railway Company has been incorporated to take over a steam railroad, 7 miles in length, extending from Ferdinand to Huntersburg. The charter provides for operating the road with steam or other motive power and for construction of branch lines. It is understood that the railway will be converted into an interurban road. The directors are: Henry Beekman, J. H. Beekman, Peter Muller and Mathias Ollinger.

COLFAX, IA.—Articles of incorporation have been filed for the Colfax Electric Light Company with a capital stock of $35,000 by A. J. and F. L. Breeden.

Personal.

MR. GEORGE MILLER has been appointed assistant superintendent of distribution for the Kentucky Electric Company, of Louisville.

MR. A. S. WITMER, formerly of the new-business department of the Wilmington (Del.) City Electric Company, has been appointed engineer of power for the Louisville Lighting Company, Louisville, Ky.

MR. M. RUSSELL ARMSTRONG has been appointed chief engineer of the municipal electric-light plant at Columbus, Ohio. Mr. Armstrong is a graduate of the Ohio State University in the class of 1911.

MR. ROSCOE WOLTZ, the newly appointed superintendent of lighting for the Ohio Valley Electric Company at Huntington, W. Va., was formerly engineer of power for the Louisville (Ky.) Lighting Company.

DR. KURT DYCKERHOFF, of Wiesbaden, Germany, is on a visit to this country in order to inspect some of the more important electrical manufacturing and operating plants, including electrochemical works.

MR. CHAUNCY L. HIGHT, recently with Wetmore, Savage Company, Boston, has accepted the management of the New York office of Henry D. Sears, Boston, and will be located at 143 Liberty Street after Nov. 1.

DR. C. P. STEINMETZ will present a paper entitled "Phenomena Beyond the Elastic Limit with Special Reference to Electrical Effect" before the Engineering Society of the Stevens Institute of Technology on April 18, 1912.

MR. J. D. LYON, manager of the electrical commercial department of the Cincinnati Union Gas & Electric Company, has been appointed a member of the committee on rate revision of the National Electric Light Association.

MR. FRANK F. FOWLE has been appointed vice-president of the Electric Club of Chicago, succeeding Mr. A. A. Gray, resigned. Mr. Fowle has also taken on himself the duties of chairman of the speakers committee of the club.

MR. PHILIP S. DODD, director of publicity National Electric Lamp Company, is making a trip through the Pacific Coast States addressing the different commercial sections of the National Electric Light Association on co-operative methods.

DR. L. R. GEISSLER, who until recently has been connected with the Psychological Laboratory of Cornell University, has accepted an appointment as associate psychologist in the physical laboratory of the National Electric Lamp Association, Cleveland, Ohio.

MR. EGBERT DOUGLAS, who has made an excellent record as commercial engineer of the Milwaukee Electric Railway & Light Company, has been promoted to be sales manager of that company, and as such will have charge of the selling work and commercial organization.

MR. NAOHIRO MORI, engineer for the Osaka (Japan) Electric Light Company, is spending a few weeks in Pittsburgh, studying the construction and erection of two 5000-kw Westinghouse turbo-generators which will be used by his company when completed. Mr. Mori is a graduate of the Osaka Technical College.

MR. J. M. KLINGELSMITH, formerly connected with the Lansden Company, of Newark, N. J., and lately in charge of the electric-truck department of the Anderson Electric Car Company, of Chicago, has been appointed western representative of the Edison Storage Battery Company, with headquarters in the People's Gas & Coke Company Building, Chicago, Ill.

MR. NORMAN G. KENON, president of the Union Gas & Electric Company, of Cincinnati, has just returned from a five-months' trip abroad, where he visited Switzerland, France and other European countries. Mrs. Kenon accompanied her husband on the trip. Mr. Rollin W. White has served as acting president of the Cincinnati company in Mr. Kenon's absence.

MR. A. M. WORTHINGTON, general manager of the Louisville Lighting Company in Louisville, was presented with a gold watch and chain by the directors of the concern last week. Mr. Worthington was forced to resign his position on account of illness and will move to a different climate. The clerks in the office also presented him with a handsome alligator handbag for traveling purposes.

GEN. GEORGE H. HARRIES has become the head of the Louisville lighting companies. As announced in these columns Oct. 7, General Harries severed his connection with the Washington public-service companies to become connected with Byllesby & Company, though at that time it was not known that he had been selected for the Louisville post. His friends and associates in Washington are to give him a banquet in November.

MR. F. X. CLEARY has resigned his position as advertising manager for the Western Electric Company, to engage in special advertising and sales promotion service. Mr. Cleary's long service as salesman, sales manager and advertising manager has given him a wide experience and acquaintanceship in the electrical field, which will continue to be his line of future effort. Mr. P. L. Thomson, formerly manager of the Western Electric Company's Pittsburgh house, has been appointed advertising manager.

MR. C. D. CHASTENEY has resigned as sales manager of the De Laval Steam Turbine Company, of Trenton, N. J., having acquired an interest in the Turbine Equipment Company, of 30 Church Street, New York, which company represents the De Laval Steam Turbine Company in New York State, parts of New Jersey and Connecticut. Mr. Chasteney was graduated from Stevens Institute of Technology in 1901, and has been with the De Laval Steam Turbine Company since the organization of the American company ten years ago.

MR. S. P. WAY, superintendent of the Union Electric Light & Power Company, of St. Louis, Mo., has been made assistant general manager of the Milwaukee Electric Company, to have charge of the light and power department, the appointment to take effect Nov. 1. Mr. R. B. Stearns remains assistant general manager directing the railway department. Mr. Egbert Douglas, who has been commercial engineer, succeeds Mr. C. N. Duffy as general sales agent, and Mr. Duffy will devote his entire time to the duties of comptroller of the company.

MR. D. STERRETT PINDELL has been added to the staff of the engineering and construction firm of C. G. Young, 60 Wall Street, New York City. Mr. Pindell has had an extensive experience in a wide range of engineering, construction and operation of public service utilities throughout the United States and Canada, including steam and electric railways, electric lighting, hydroelectric power development, building construction, etc. His present activities will be especially in connection with examinations and reports of which the firm he joins makes a specialty.

MR. J. R. TOWNSEND, formerly electrical engineer of the Mahoning & Shenango Railway & Light Company, Youngstown, Ohio, with which he was associated for five years, and recently sales engineer in charge of the power house and railway equipment division of the Westinghouse Electric & Manufacturing Company, Detroit district office, has accepted the management of the Portland (Ore.) district office of J. C. Farrar & Company, who are Pacific Coast agents for the Lord Manufacturing Company and the Electrical Engineers' Equipment Company and also are contracting electrical engineers. Along this line Mr. Townsend will have charge of the construction of the switchboard and busbar portion of electric power houses, in which field his principals are specialists.

MR. CHARLES S. JOHANN has resigned as sales engineer of the Allis-Chalmers Company to accept the position of secretary and general manager of the Morris & Somerset Electric Company with headquarters at Morristown, N. J. Mr. Johann, after passing through the apprentice course at the Westinghouse shops at East Pittsburgh, served both in the engineering department and the sales department of the Westinghouse Electric Manufacturing Company. Later he was connected with the American Railways Company as general superintendent at Springfield, Ohio, where he designed and built a large power house for the lighting company; the Westinghouse Machine Company, as manager of its Baltimore office; Dodge & Day, Philadelphia, Pa., as engineer; E. W. Clark & Company, as constructing engineer, during which connection he enlarged and rebuilt the plant of the St. Joseph Railway, Light, Heat & Power Company, St. Joseph, Mo., and the Lewisburg, Milton & Watertown Passenger Railway Company as chief engineer. Mr. Johann retains his position with the Lewisburg, Milton & Watsontown Passenger Railway Company and the properties which that interest controls.

Obituary.

MR. HENRY F. FROSCH, of Henry F. Frosch & Company, electrical supply dealers and representatives of the Federal Electric Company in San Francisco, died suddenly on Sept. 27. Some years ago Mr. Frosch was employed by the Commonwealth Edison Company, of Chicago, and he was well and favorably known in that city, as well as in San Francisco. The body was brought to Chicago for burial.

MR. ROBERT MATHER, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, died at his home in New York on Tuesday morning, Oct. 24, from acute peritonitis. Mr. Mather was born July 1, 1859, at Salt Lake City, and received his early education in the public schools of Galesburg, Ill. Owing to the necessity of making his own living, he left high school at the age of thirteen, and for three years was employed in a factory engaged in the manufacture of telegraph instruments, subsequently obtaining employment in the office at Galesburg of the master mechanic of the Chicago, Burlington & Quincy Railroad. While working there he prepared for college by studying at night. In 1882 he was graduated from Knox College, and by continuing his night studies, working by day at railroading, he obtained three years later the degree of A.M. from that college. Recently the degree of LL.D. was conferred on him by Knox College, of which he was one of the trustees at the time of his death. From 1882 to 1885 Mr. Mather worked in the treasurer's office of the Chicago, Burlington & Quincy Railroad, devoting his spare time to the study of law, and in 1886 he was admitted to the Illinois bar. In 1889 he became attorney at Chicago for the Chicago, Rock Island & Pacific Railroad, and in 190

ROBERT MATHER.

was elected general counsel for the road. In the meantime he had occupied various offices of the road, including that of second vice-president. In 1889 he became chairman of the excutive committee and in 1904 president of the Rock Island Company of New Jersey. In 1903 he was elected third vice-president of the St. Louis & San Francisco Railroad, the following year becoming first vice-president. He was also first vice-president of the Chicago & Eastern Illinois Railroad and of the Evansville & Terre Haute Railroad, and chairman of the board of directors of the St. Louis, Kansas City & Colorado Railroad. Mr. Mather was a director in a large number of important corporations, including the National Bank of the Republic, of Chicago, and the Mercantile Trust Company, American Realty Company, and Equitable Life Insurance Company, of New York. He was also interested in the development of the traction system of Havana, being a director of the Havana Electric Railway Company. In January, 1909, Mr. Mather was made chairman of the bord of directors of the Westinghouse Electric & Manufacturing Company, and thereupon severed his railroad connections and concentrated his work on the Westinghouse interests. Mr. Mather was a man of forceful character and positive methods which gave him a dominating influence in any interest with which he was closely associated. Funeral services were held in New York on Wednesday, and the burial took place from Plymouth Church, Chicago, on Friday.

Trade Publications.

ELECTRIC GLASSWARE.—The Haskins Glass Company, Wheeling, W. Va., has issued Catalog No. 16, devoted to gas, electric incandescent and arc-lighting glassware and a booklet on the Haskins-Lucida glassware for incandescent lamps. The latter is highly translucent and yet gives excellent diffusion. It possesses reflecting power as well and is made up in a number of standard shapes. It has a pearly lustre and is smooth on both surfaces, so that it is readily kept clean.

IRIDESCENT GLASSWARE.—Catalogue No. 53 of the Fostoria Glass Specialty Company, Fostoria, Ohio, entitled "Iris Illuminating Glassware," lists, describes and illustrates over 300 different styles of shades and reflectors in colored and iridescent patterns for gas and electric lamps. It conforms in size of page and general conception to the same company's 100-page Catalogue No. 52 on cut and etched ware with the additional feature that each of the ten distinct motifs employed in the decorating of the "Iris" ware is illustrated by a three-color cut. The colored plates bring out, so far as it is possible for cuts to do, the delicate shadings and blending tints which constitute much of the beauty of art glass, although it is not found practical to reproduce through the medium of printer's ink the play of iridescent colors that is characteristic of many of the types shown.

HOT BLAST HEATING AND VENTILATING OUTFITS.—In a ninety-four page book bearing the title "Heating and Ventilating" the Green Fuel Economizer Company, of Mattewan, N. Y., has brought together the information required for the designing and proportioning of hot blast outfits for heating, ventilating, drying, etc. The book contains several dozen tables of temperatures required in rooms for various purposes; on heat transmission through building materials; heat given off by occupants and by lamps, standard sizes of hot-blast heaters, frictional resistance of air washers, relative humidities, humidities and temperatures throughout the United States, amounts of air required for ventilation, equivalent air pressures, velocities and horse-powers; total weight of air at various pressures and temperatures; pressure and power consumed in friction; speed, capacity and power of steel-plate fans; friction of air through hot-blast coils, etc. The text takes up not only the usual details relating to the construction of fans, heaters and heating and ventilating systems, but also the calculation and designing of piping systems. There is also a chapter on the loss of head of air flowing through orifices and equivalent orifices, in which is presented a method of combining the resistances of ducts in parallel and series connections analogous to Ohm's and Kirchoff's laws for electrical circuits. Another chapter gives the result of an extensive series of tests upon Green's "Positiv-Flo" steam heating coils, by means of which heaters of suitable sizes may be selected for any given duty. The general illustrations of the book include not only views of buildings equipped with heating and ventilating apparatus built by the Green Fuel Economizer Company, but also detailed plans, elevations and "ghost" views showing the actual arrangement of the fans, heaters, piping, outlets, etc.

BUSINESS NOTES.

MINERALLAC ELECTRIC COMPANY.—The Minerallac Electric Company has removed its offices from No. 400 South Hoyne Avenue to the Merchants' Loan and Trust Building, Chicago.

THE STATES ELECTRIC COMPANY has moved its office and factory to more commodious quarters at 622-630 West Adams Street, Chicago, where the company has much increased facilities for handling work.

THE HESS-BRIGHT MANUFACTURING COMPANY, of Philadelphia, makers of ball bearings, announces that word has been received from the Deutsche Waffen und Munitionsfabriken, which the Hess-Bright company represents as importers, that the "DWF" have just been awarded the "Gran Premio" at the International Industrial and Trade Exhibition of Turin, this being the highest distinction.

THE ECONOMY SWITCH BOX & MANUFACTURING COMPANY, Cleveland, Ohio, has appointed W. M. Sheehan & Company, 136 Liberty Street, New York, its Eastern representatives for the territory including New York, New Jersey and New England. A full stock of Economy switch boxes, switch plates and the other specialties will be carried at all times.

THE ILG ELECTRIC VENTILATING COMPANY, Chicago, manufacturer of air-cooled motor fans, blowers and exhausters, has established a branch office at 13 Park Row, New York, in charge of Mr. George Breidert, an experienced engineer and expert on fan and blower work. A full line of direct-connected fans and blowers, including forge blowers, etc., will be kept in stock in New York for immediate delivery.

THE DONGAN ELECTRIC MANUFACTURING COMPANY, Detroit, Mich., has appointed Mr. Arthur P. Pierson, of 136 Liberty Street, New York City, as sole selling and distributing agent for its entire line of bell-ringing, toy, Christmas-tree lighting and sign-lighting transformers. Mr. Pierson, who has long been actively identified with the electrical business, has undertaken the marketing of the entire output of this line.

THE LOUISVILLE GAS & ELECTRIC FURNITURE COMPANY, which started business in Louisville, Ky., a short time ago, is doing unusually well, and the management is well pleased with surrounding trade conditions. Mr. E. T. Martin, who for twenty years has been connected with an electrical concern of Chicago, has taken charge of the chandelier and furniture section of the business, and Mr. A. G. Boebel, who has been doing electrical work in the Falls cities for a number of years, is to assume charge of the electrical department. The traveling agents and road members of the establishment will be under the direction of Mr. George Reno, who was connected with a similar business in Chicago.

THE MOORE LIGHT COMPANY has made a number of installations in New York recently, including long Moore tubes for the show windows of R. M. Haan, at 505 Fifth Avenue, and Madame Clarice, at 1548 Broadway. New work has been completed in the Baltimore Dairy Lunch Rooms on Twenty-third Street and Beekman Street, and in the uptown office of the New York *World*. The wholesale houses of Cheney Brothers, 216 Fourth Avenue, and Albert Godde, Pedin & Company, 13 West Twentieth Street, have been equipped with color-matching installations with the white Moore light. The fact that the white Moore tube shows all colors in their true values has induced many textile manufacturers recently to utilize this form of illumination, including the Rhode Island Worsted Company, Stafford Springs, Conn.; J. H. & C. K. Eagle, Shamokin, Pa.; Cheney Brothers, South Manchester, Conn.; Footer's Dye Works, Cumberland, Md., and the American Thread Company, Willimantic, Conn.

SALES REPRESENTATIVES OF THE ESTERLINE COMPANY.—The Esterline Company, Lafayette, Ind., manufacturers of the Esterline graphic meter and the Berdon electric-lighting system for motor vehicles, announces the appointment of the following sales representatives. These concerns will handle a complete line of Esterline Company's product in the cities named, and will give the company's customers technical service of every kind and character: New York City, Mr. Mortimer L. Newman, 114 Liberty Street; Atlanta, Ga., the Automobile Specialties Company, Mr. L. O. Surles, manager, 222-234 Peachtree Street; Denver, Col., Western Engineering & Specialties Company, 1732 Glenarm Street; San Francisco, Cal., the Symonds-Berle-Kirkpatrick Company; Los Angeles, Cal., the Symonds-Berle-Kirkpatrick Company; Cleveland, Ohio, Chas. F. Saenger & Company, 210 Electric Building; Boston, Mass., the Standard Engineering Company, 53 State Street; New Haven, Conn., the Standard Engineering Company, 810½ Chapel Street; Waterbury, Conn., the Standard Engineering Company, 16 East Main Street.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 17, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,005,794. TROLLEY; S. M. Balzer, Andover, N. J. App. filed Oct. 28, 1907. The trolley wheel is mounted on a bearing so as to have a pivoted as well as rotary movement.

1,005,797. TROLLEY GUARD AND FINDER; H. E. Bayer, Pittsburgh, Pa. App. filed June 13, 1910. Has diverging finding arms locked to the harp and unlocked by the rope.

1,005,805. ADJUSTABLE SERIES SHUNT; A. J. Brown, Milwaukee, Wis. App. filed Feb. 14, 1910. A zigzag strip with an adjustable short-circuiting clamp.

1,005,842. ELECTROMOTOR; B. F. Hutches, Jr., Allendale, N. J. App. filed June 17, 1910. A central stationary field and an outer rotating armature; particularly for small motors.

1,005,846. ELECTRIC-WIRE TERMINAL CLIP; J. H. Kaesen, New York, N. Y. App. filed Dec. 2, 1910. Gripping jaws are closed by turning a sleeve; for spark-plugs, etc.

1,005,853. EDUCATIONAL TOY; L. B. Lewis, Columbus, Ohio. App. filed June 24, 1911. A horseshoe magnet having a continuous track and a rotatable keeper.

1,005,855. ALTERNATING-CURRENT ELECTROMAGNET; D. L. Lindquist, Yonkers, N. Y. App. filed June 16, 1909. A longitudinally laminated core with secondary conductors, each inclosing a fractional number of the laminations.

1,005,856. ALTERNATING-CURRENT ELECTROMAGNET; D. L. Lindquist, Yonkers, N. Y. App. filed Feb. 9, 1910. The magnetic fluxes due to the primary and secondary circuits differ in phase, and a selected ohmic resistance is inserted in the secondary.

1,005,857. ALTERNATING-CURRENT- ELECTROMAGNET; D. L. Lindquist, Yonkers, N. Y. App. filed Feb. 9, 1910. Has stationary and movable cores with a secondary on each.

1,005,858. DYNAMO-ELECTRIC MACHINE; C. E. Lord, Norwood, Ohio. App. filed Sept. 24, 1906. Removable pole shoes are split into two portions so that one with its windings may be removed from the other.

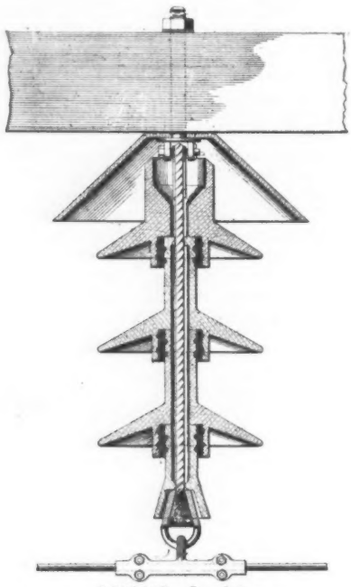
1,005,862. PRINTING TELEGRAPH; A. S. McCaskey, Chicago, Ill. App. filed May 3, 1901. The transmitter has a keyboard like a typewriter. Sets of pole changers are acted upon successively by the keys and brought into connection with the main line subsequent to the operation of the keys.

1,005,866. MEANS OF PREVENTING AN ELECTRIC DISCHARGE THROUGH A GAS COLUMN; D. McF. Moore, Newark, N. J. App. filed April 7, 1906. Sand permits gas circulation, but prevents high-potential discharge.

1,005,867. VACUUM-TUBE LIGHTING; D. McF. Moore, Newark, N. J. App. filed May 8, 1906. Gas is fed into a tube for modifying the spectrum.

1,005,870. DEVICE FOR SUPPORTING ARTICLES IN AN ELECTROPLATING BATH; M. L. Packer, Columbus, Ohio. App. filed Feb. 3, 1911. A vertical rod with bent wire hooks.

1,005,874. SPACER AND BRACER FOR COMMUTATOR NECKS; H. H. Ralston, Norwood, Ohio. App. filed Aug. 1, 1907. Spacing



1,006,040.—Insulator.

blocks between the commutator necks to prevent crosswise and edgewise vibration.

1,005,880. METHOD OF FORMING JOINTS IN METAL; A. F. Rietzel, Lynn, Mass. App. filed Oct. 2, 1906. One or both elements are provided with flanges and the parts pressed together and electrically welded.

1,005,899. SWITCH; G. G. Stout, Parkersburg, W. Va. App. filed Sept. 26, 1907. A solenoid magnet and armature for closing a lighting circuit.

1,005,904. SYSTEM OF ELECTRICAL DISTRIBUTION; H. L. Van Valkenburg, Norwood, Ohio. App. filed Feb. 19, 1906. For transferring a voltmeter or a synchronizer from one generator to another or to the busbars.

1,005,905. SYSTEM OF ELECTRICAL DISTRIBUTION; H. L. Van Valkenburg, Norwood, Ohio. App. filed Feb. 28, 1906. A plurality of generators in parallel. Switches are arranged so as to prevent a voltmeter or synchronizer from being thrown into circuit unless all the switches are in their normal positions.

1,005,910. KEY SWITCH; A. H. Weiss, Chicago, Ill. App. filed March 23, 1905. Telephone switchboard keys are returned by helical springs.

1,005,926. ELECTRIC SWITCH; R. B. Benjamin, Chicago, Ill. App. filed July 18, 1907. A pull switch for turning on and off one or more lamps of a cluster.

1,005,937. SYSTEM OF ELECTRICAL DISTRIBUTION; H. W. Cheney, Milwaukee, Wis. App. filed Oct. 6, 1909. A number of circuit-breakers may be closed independently and tripped simultaneously.

1,006,003. AUTOMATICALLY CONTROLLED MIXING MACHINE OR THE LIKE; N. Pecci, Paterson, N. J. App. filed April 5, 1911. A dough mixer is driven by an electric motor which can be set to stop after a desired number of revolutions.

1,006,005. CIRCUIT-CLOSER; F. A. Pierce, Wheeling, W. Va. App. filed Nov. 6, 1909. Operated by an approaching train to actuate mechanism for applying train brakes.

1,006,021. ELECTRIC LIGHTING; C. P. Steinmetz, Schenectady, N. Y. App. filed April 30, 1900. A vaporous color-modifying substance is introduced into an envelope and its chemical activity with reference to the envelope is neutralized.

1,006,040. INSULATOR; J. Alsberg, New York, N. Y. App. filed July 29, 1907. Spun glass formed into a flexible cable or hanger.

1,006,041. INSULATOR; J. Alsberg, New York, N. Y. App. filed Sept. 28, 1908. A flexible insulating cable hanger surrounded by a tubular member.

1,006,042. INSULATOR; J. Alsberg, New York, N. Y. App. filed June 17, 1909. A flexible insulating member surrounded by connected petticoated insulators.

1,006,069. ELECTROMAGNETIC IGNITING DEVICE FOR ARC LAMPS; K. von Dreger, Berlin, Germany. App. filed Feb. 15, 1910. The carbons are arranged side by side and one is movable to start the arc.

1,006,079. SUBMARINE SOUND SIGNALING; J. Gardner, Knott End, England. App. filed March 10, 1908. Construction and arrangement of diaphragm and contacts for augmenting sound in the receiver.

1,006,089. ALTERNATING-CURRENT RELAY; J. F. D. Hoge, New York, N. Y. App. filed April 11, 1910. The vibrating member is mounted so as to have also a bodily movement.

1,006,090. ALTERNATING-CURRENT RELAY; J. F. D. Hoge, New York, N. Y. App. filed July 27, 1910. The armature has an adjustable nodal point.

1,006,091. ALTERNATING-CURRENT RELAY; J. F. D. Hoge, New York, N. Y. App. filed Sept. 23, 1910. The armature is weighted to provide a stationary node.

1,006,103. METHOD OF MAKING BALL BEARINGS; O. C. Knipe, Washington, D. C. App. filed Dec. 20, 1909. The inner sleeve or core is formed of two parts welded together.

1,006,104. ELECTRIC HEATER; R. and F. Kuhn and F. E. Shailor, Detroit, Mich. App. filed June 11, 1910. Detachably locks the vessel to the heater.

1,006,112. PRINTING TELEGRAPH SYSTEM; A. S. McCaskey, Chicago, Ill. App. filed May 3, 1901. Receiving mechanism comprising a distributor, a selector and a printing device such as a typewriter.

1,006,129. COMBINATION ELECTRIC HEATER; E. H. Richardson, Ontario, Cal. App. filed Nov. 9, 1909. Laundry iron, stove, water heater or curling-iron heater.

1,006,140. POLE-REVERSING SWITCH AND WIRING SYSTEM; O. R. and O. M. Simenson, Olympia, Wash. App. filed Oct. 27, 1910. Wall or ceiling type with rotary thumb turn.

1,006,148. ELECTRICAL SWITCH; C. L. Terry and P. Townsend, Cleveland, Ohio. App. filed Jan. 17, 1910. A switch lever with catches inside the casing to prevent withdrawal of the terminal plugs.

1,006,193. ELECTRIC SWITCH; H. J. Ford, San Quentin, Cal. App. filed April 18, 1911. Solenoids for operating a railroad-track switch.

1,006,198. SEAL FOR SECTIONAL LEADING-IN WIRES; T. W. Frech, Jr., Cleveland, Ohio. App. filed Jan. 10, 1907. For incandescent lamps.

1,006,235. POLICE-SIGNALING AND CONTROLLING SYSTEM; C. C. Lamb, Chicago, Ill. App. filed Oct. 5, 1909. A chart at a central precinct has movable members indicating the location of the patrolmen on their beats.

1,006,268. INSULATOR-BRACKET; C. L. Peirce, Jr., Pittsburgh, Pa. App. filed Oct. 26, 1910. The bracket is supported between two angle irons.

1,006,296. ELECTRIC SWITCH; F. E. Seeley, Bridgeport, Conn. App. filed May 19, 1911. A pull-socket lamp with return-spring adjustment accessible only from the lamp end.

1,006,301. HOLDER FOR CURRENT COLLECTORS; O. M. Shirley, New Brighton, Pa. App. filed March 22, 1911. For electric cranes, etc. A grooved rectangular block is held in place by springs.

1,006,330. OBTAINING ZINC AND (OR) COPPER FROM COMPLEX ORES OR THE LIKE; J. R. Williams and H. W. and B. Bradley, Sheffield, England. App. filed Aug. 9, 1909. Silicate-containing ores are subjected to dilute sulphuric acid and then electrolyzed.

1,006,333. VAPOR ELECTRIC LAMP; H. I. Wood, Schenectady, N. Y. App. filed Feb. 14, 1903. A carbon filament normally lightly touching the surface of one electrode provides a starting path.

1,006,344. PRINTING TELEGRAPH; M. S. Ayau, New York, N. Y. App. filed Nov. 14, 1907. The message is typewritten, transmitted and transcribed at the receiving station with a single circuit using two current-strength impulses.

1,006,354. RAILBOND; I. W. Burgess, Minden, W. Va. App. filed May 26, 1911. Tubular shanks are wedged into the rail ends.

1,006,382. OVERHEAD TROLLEY; J. H. Howard, Kansas City, Kan. App. filed Nov. 10, 1903. The trolley wheel controls pressure mechanism for maintaining uniform pressure on the wire.

1,006,389. ELECTROLYTIC MANUFACTURE OF DIFFICULTLY SOLUBLE SALTS OR HEAVY METALS; C. Lukow, Cologne, Germany. App. filed Jan. 20, 1910. The electrolyte contains a mixture of a "dissolving salt" and a "precipitating salt."

1,006,394. ELECTRIC PUSH-BUTTON; J. L. Morrell, New York, N. Y. App. filed June 9, 1911. Spring with center-wedge contact for bell circuits, etc.

1,006,415. ELECTRIC GARMENT; A. C. Stubling and F. C. Gibson, Portland, Ore. App. filed Jan. 30, 1911. A coat with horizontal heater elements and switches.

1,006,421. VAPOR ELECTRIC LAMP; H. L. Wood, Schenectady, N. Y. App. filed Feb. 14, 1903. The lamp is started by current through a carbon filament.

1,006,429. APPARATUS FOR TRANSMITTING SOUND WAVES; F. H. Brown, Los Angeles, Cal. App. filed April 17, 1907. Electromagnetic wireless.